TE TAI ŌHANGA
THE TREASURY

New Zealand's wellbeing: Is it sustainable and what are the risks?

Background paper to Te Tai Waiora: Wellbeing in Aotearoa New Zealand 2022

November 2022

Te Kāwanatanga o Aotearoa
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BACKGROUND PAPER TO TE TAI WAIORA: WELLBEING IN AOTEAROA NEW ZEALAND	New Zealand's wellbeing: Is it sustainable and what are the risks?
MONTH/YEAR	November 2022
AUTHORS	Margaret Galt Principal Advisor The Treasury Email margaret.galt@treasury.govt.nz
	Chris Nees Principal Advisor The Treasury Email chris.nees@treasury.govt.nz
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NZ TREASURY	New Zealand Treasury PO Box 3724 Wellington 6008 NEW ZEALAND Email information@treasury.govt.nz Telephone 64-4-472 2733 Website www.treasury.govt.nz

Executive summary

This is part of a suite of papers designed to support the Treasury's first Te Tai Waiora Wellbeing Report. It is particularly focused on the requirement under the Public Finance Act 1989 for the Treasury to report on "sustainability of and any risks to the state of wellbeing in New Zealand". It is focused on providing the key insights on this issue from the available evidence.

Sustainability implies thinking long term, asking something like the following question:

> Given our activities today, are we likely to leave our children with a stock of national wealth that enables them to have at least the same opportunities to meet their wellbeing aspirations as we had?

This question critically involves the pressures that our activities today may be placing on various aspects of national wealth and therefore its ability to support wellbeing into the future. It necessarily involves decade-scale timeframes, especially because many of New Zealand's risks are high-impact, rare events that occur over that kind of timescale.

We have focused our sustainability assessment on the four aspects of wealth (formerly the capitals) in The Wealth of Aotearoa New Zealand level of the Treasury's Living Standards Framework. These aspects of wealth are resource pools that underpin our individual and collective wellbeing. We also look at sustainability using some components of He Ara Waiora, but to a lesser extent purely because there is currently less evidence available based on these concepts.

Given the scale of this issue, we have not tried to be comprehensive. Instead, we focus on three key questions:

- What do we know about whether New Zealand's overall wealth is increasing, declining or staying the same?
- What major risks does New Zealand face that could undermine future wellbeing?
- Given the character of these risks, what is the best way in which to build resilience to limit the impact of the risks on the sustainability of future wellbeing?

We cannot answer these questions as clearly as we would like because there is still considerable academic debate about the best way to approach these questions. Therefore, this paper is the first step rather than a final conclusion.

What do we know about the overall sustainability of our wealth into the future?

The sustainability of wellbeing depends partly on whether we are maintaining the four aspects of our wealth: our physical and financial capital, the natural environment, our human capability, and social cohesion. Measuring how our national wealth is evolving could give insight into whether we are leaving future generations the resources they will need to sustain wellbeing. At this stage, the overall trend in the relevant empirical measures are not robust enough to be definitive, largely because the valuation of our natural environment varies depending on the methodological differences between the World Bank and the United Nations. We have tentatively concluded that the measured value of our human and physical wealth has been increasing since 1995, and our social cohesion is high by international standards. The value of our natural environment has either slightly increased or slightly decreased, depending on how it is measured.

There are a range of threats to the sustainability of the natural environment, including the likely impact of climate change. In the past we in Aotearoa New Zealand have accepted a deteriorating natural environment as a price worth paying for improving wealth in other areas, But aspects of the natural environment are deteriorating and the climate is changing,suggesting that our current way of life may not be sustainable. If this is the case, sustaining wellbeing will depend on whether technological innovation, productivity growth and societal choices will allow us to adapt. For example, sustaining wellbeing may depend on our ability to adapt to emitting less greenhouse gases and living in a warmer climate.

Aggregate measures are only part of the story. Looking at the individual aspects of our wealth gives a better understanding of our strengths (for example, growing returns from higher skill levels, relatively high levels of trust) and weaknesses (for example, a range of poor biodiversity outcomes and growing impacts from climate change).

Risks to our wellbeing are clear and significant

We know that the risk landscape is changing. We face the consequences of a rapidly changing climate, and we also have evidence that suggests we are breaching other key planetary limits (notably biodiversity and phosphorus and nitrogen use). In addition, the geopolitical environment has been deteriorating in a way that may reduce the ability of the world to address major issues that require cooperation, from solving environmental issues to the gains from an open trading system.

Our location on the Ring of Fire means we also have a very high proportion of high-impact, inevitable but rare events (HIREs), some of which are so unpredictable in both when they will occur and what impact they would have that they may be close to ‘black swans’ (or unknown unknowns). These events could at any stage detrimentally impact our wellbeing, and coping with them is more difficult because we are a small country.

At the same time, New Zealand faces many slow-onset risks where the impacts accumulate over time, notably declining youth educational performance, which could undermine the growth of our human capital, and some signs of declining trust undermining our social cohesion.

Our ability to adapt to these challenges will determine their impact on wellbeing

New Zealand has systems in place that enable us to prepare for and, where possible, prevent certain key risks. These range from systems to prevent harm such as building codes, those that spread the risk such as insurance, including Toka Tū Ake EQC, and those that assist with coping with the immediate aftermath of an event such as civil defence. Such systems can minimise the impact and speed up recovery.

This prior preparation is important, but a key difference between New Zealand and most other countries is that our risk profile is highly skewed towards the less predictable and more catastrophic HIREs, which means our ability to react is at least as important as preparation. The literature suggests our future wellbeing will be more sustainable in the face of these events if we have good decision-making institutions, strong social connections in the community and access to resources that can be repurposed to whatever is needed. Whether it was during the Christchurch and Kaikōura earthquakes or the COVID-19 events, the role of adaptable people and the strength of the Government's balance sheet in supporting recovery has been significant.

The evidence on the current state of our resilience is not as strong as we would like, but what is available suggests that we do have good decision-making institutions and that our relatively high levels of social cohesion, particularly our high level of trust in Government, means we are relatively resilient relative to many other countries.

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Introduction

Purpose and scope

This paper is one in a series the Treasury commissioned to support the first Te Tai Waiora Wellbeing Report, published in November 2022.

Te Tai Waiora Wellbeing Report is a new stewardship document that the Treasury must produce every four years following the passage of the Public Finance (Wellbeing) Amendment Act 2020. Te Tai Waiora Wellbeing Report will sit alongside the Long-term Fiscal Statement, Investment Statement and Long-term Insights Briefing as part of a suite of regular strategic assessments by the Treasury of Aotearoa New Zealand's economic, fiscal, social and environmental health.

Te Tai Waiora Wellbeing Report has the broadest scope of the four reports. The relevant section of the Public Finance Act 1989 requires the Treasury, using indicators, to describe:

- the state of wellbeing in New Zealand
- how the state of wellbeing in New Zealand has changed over time
- the sustainability of and any risk to the state of wellbeing in New Zealand.

Rather than attempt to cover this scope comprehensively in a single document, we will be publishing a series of more-detailed working papers and analytical papers over the course of this year to support the final report. These will be available from the Treasury website as these are released. These papers will be capped by a final report in November 2022, Te Tai Waiora Wellbeing Report itself, which will be a shorter document drawing together the key conclusions from the more-detailed analytical pieces.

This paper addresses the third requirement of the legislation. It uses the available data and evidence to provide an overview of the risks to and sustainability of wellbeing in New Zealand. It is focused on risks to national wellbeing, not risks to the current wellbeing of individuals, communities or subgroups

Our approach

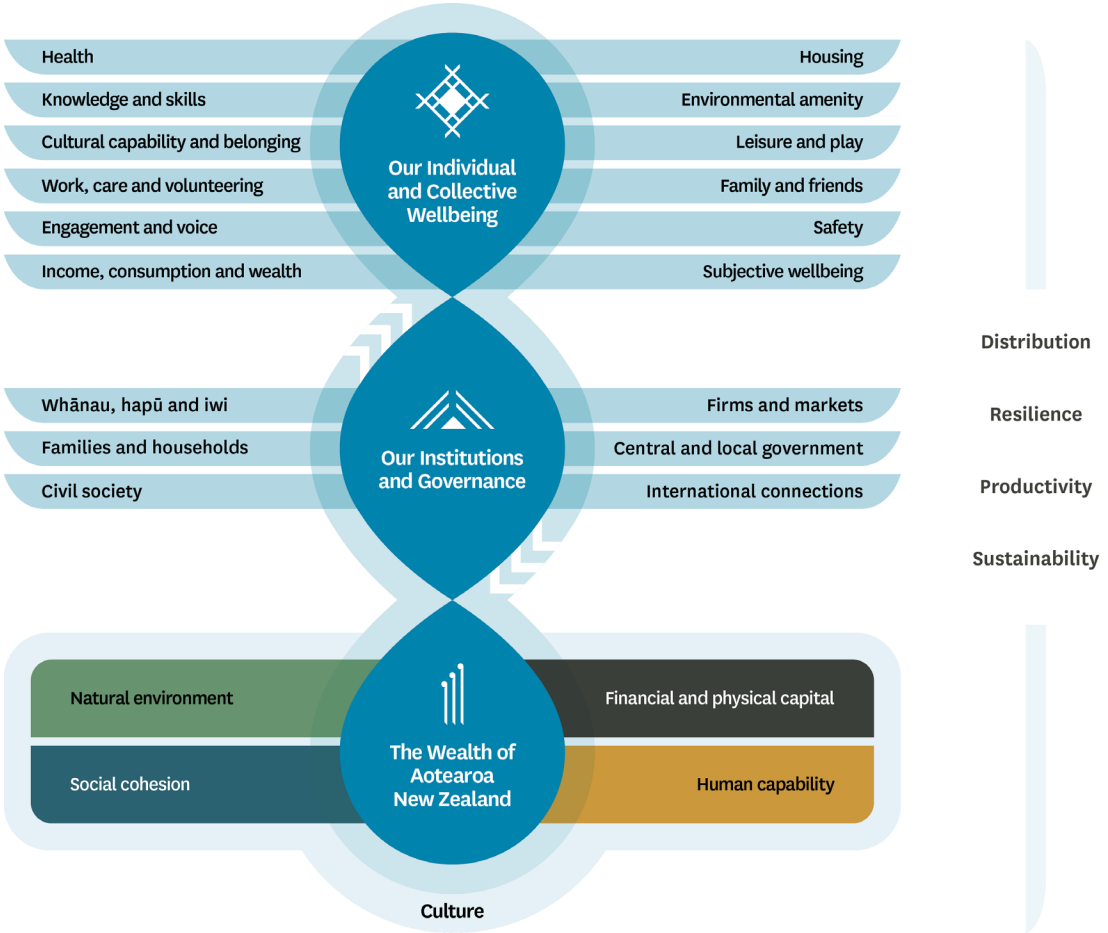
As noted, the requirements in the Public Finance Act for Te Tai Waiora Wellbeing Report are broad and leave scope for interpretation. Some of the key choices we have made regarding interpretation are summarised in this section.

This paper uses the Living Standards Framework and He Ara Waiora to conceptualise wellbeing

This paper uses the conceptual framing of the Living Standards Framework and He Ara Waiora. Doing so means we can take advantage of work in the Treasury over the past decade to confront the deep questions of the nature of wellbeing.

This paper focuses on two of the three levels of the Living Standards Framework: the four aspects of our wealth and the role of institutions and governance in managing risks and building resilience (Figure 1). For more information about the definition of each element of the framework and rationale for defining them in the way we have, refer to the recent Treasury paper (The Treasury, 2021c).

Figure 1: The Living Standards Framework



He Ara Waiora presents a holistic, intergenerational approach to understanding wellbeing (Figure 2). It articulates the **ends** – the important elements in Māori perceptions – and the **means** – the tikanga values or principles that help us achieve the ends.

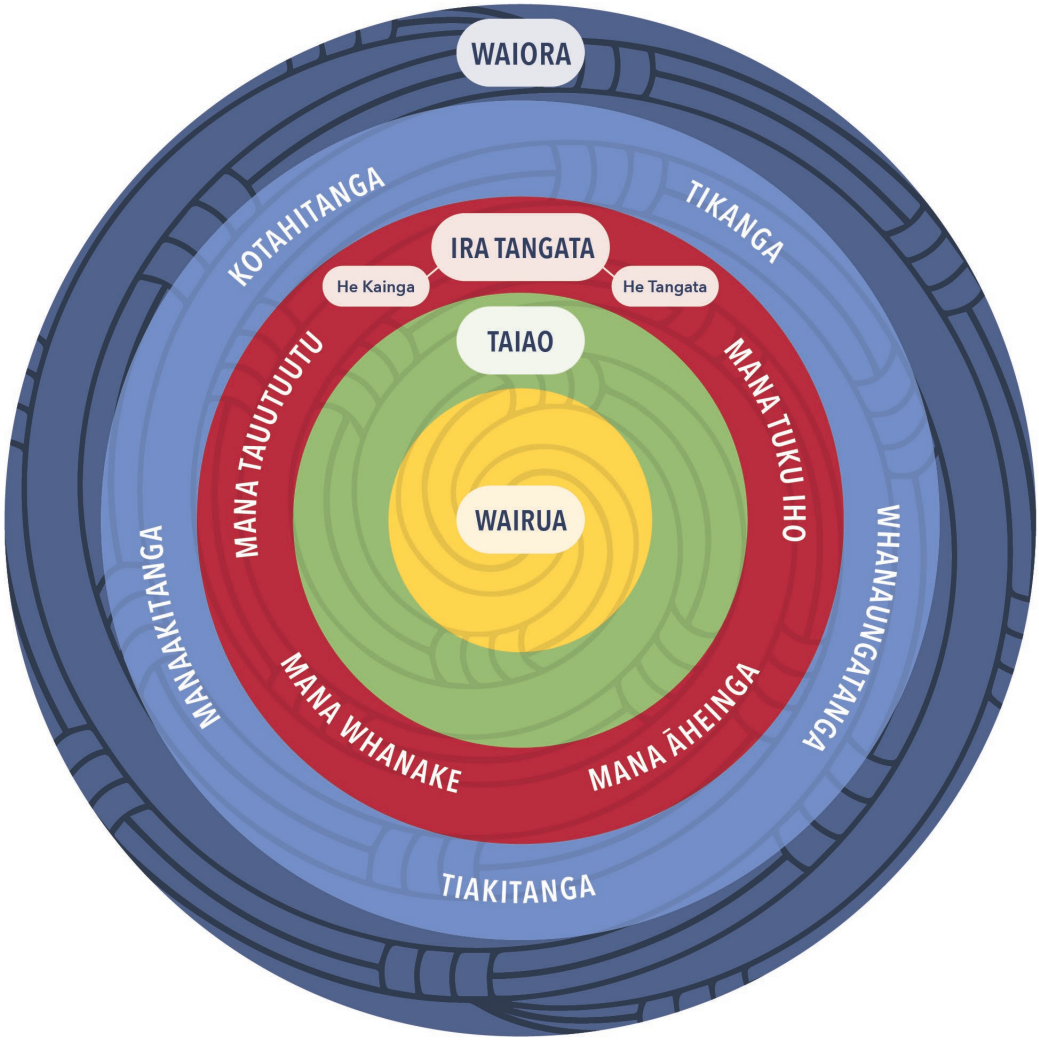
The ends are Wairua (spirit), the foundation or source of wellbeing, Te Taiao, the natural world which is paramount and inextricably linked with wellbeing, and Te Ira Tangata, which encapsulates human activities and relationships, including relationships between generations. The concept of **mana** (power, authority that includes self-determination and dignity) is seen as key to wellbeing.

Values, beliefs, and practices related to Wairua are at the centre of Māori concepts of wellbeing. This sense of spirituality imbues the aspects of wellbeing expressed in Te Taiao and Te Ira Tangata.

The ‘means’ or principles and behaviours set out in He Ara Waiora that support wellbeing, are **Kotahitanga** (working in an aligned, coordinated way), **Tikanga** (using the right values and processes), **Whanaungatanga** (maintaining and utilising relationships through kinship or shared experience), **Manaakitanga** (enhancing the mana of others) and **Taikitanga** (guardianship, stewardship – including of the environment). All are useful guiding principles for risk management.

The key values that shape Māori intergenerational practices for facilitating whakaoranga (rescue, recovery and restoration of sustainable wellbeing) include kotahitanga, whānau (family), whakapapa (genealogy), marae (communal and sacred meeting grounds), whakawhanaungatanga (building/maintaining relationships), manaakitanga and kaitiakitanga (guardianship). From a Māori perspective, such values link with a set of practices that must be learned and enacted through giving time and support for the collective good rather than one’s own wellbeing.

Figure 2: He Ara Waiora



We focus on the four aspects of wealth and the ends

The third legislative requirement focuses on the future. It asks the Treasury to report on how wellbeing might look then rather than how it looks now. For this purpose, we are taking a multi-decade, intergenerational view.

This is consistent with the approach by international organisations, notably the OECD (Stiglitz et al, 2018, Chapter 9), the World Bank (2021) and the United Nations Environment Programme (2018), and it is also the approach recommended by Stiglitz et al. (2009, especially section 4.5) for assessing the long-term wellbeing of societies. Considering national wealth broadly – especially considering human capability, the natural environment and social cohesion as components of wealth – is an increasingly common approach to evaluating sustainability in scholarly research.

> *Humanity's future will be shaped by the portfolio of assets we inherit and choose to pass on, and by the balance we strike between the portfolio and the size of our population.*
>
> *Dasgupta, 2021, p. 323*

In his major review for the UK Treasury, Partha Dasgupta (2021) highlighted the role that the aspects of wealth or capitals, which he calls "assets", play in humanity's future. Evidence suggests that the future wellbeing of our country will be driven by the legacy of resources we leave to them along with the technological innovations that they create. In terms of our frameworks, this legacy is best captured by the expected trajectory of each of the aspects of our wealth and the ends in He Ara Waiora.

This paper should be read as part of a suite of papers

The Treasury has published a series of papers on each aspect of our wealth, then called capitals (Janssen, 2018; Frieling, 2018; Morrissey, 2018; van Zyl & Au, 2018). Each was entitled "The start of a conversation …" because our thinking is less developed on these than on indicators for individual and collective wellbeing. In addition, we have previously published some thinking on resilience (Frieling & Warren, 2018) and its role in future wellbeing and He Ara Waiora (The Treasury, 2021b).

Internationally, the role of the aspects of wealth in the Living Standards Framework and ends in He Ara Wairoa (often called capitals or assets in the academic literature) is subject to a lot of uncertainty and academic debate. This has consequences for this paper. It means that, in many places, our best judgements are subject to considerable uncertainty and that more work and thinking is needed. For this reason, this paper should also be seen as the start of a conversation. We expect that future Te Tai Waiora Wellbeing Reports will extend this initial analysis.

This paper has also drawn on more-detailed work for this Te Tai Waiora Wellbeing Report on the state of natural, human and social capital. These will cover in detail the evidence about the state of these aspects of our wealth. This report focuses on the aggregate. It is important to read this report in the context of this wider set of evidence.

What this paper covers – and what it does not

This paper is a summary of the available evidence about the overall risks to and sustainability of wellbeing.

It is focused on the overall sustainability of wellbeing – it does not attempt to be exhaustive. It looks across each of the aspects of our wealth and ends to better understand the overall sustainability of wellbeing and the major risks that might undermine wellbeing in the future. It does not consider local risks or risks to individual components of our wealth.

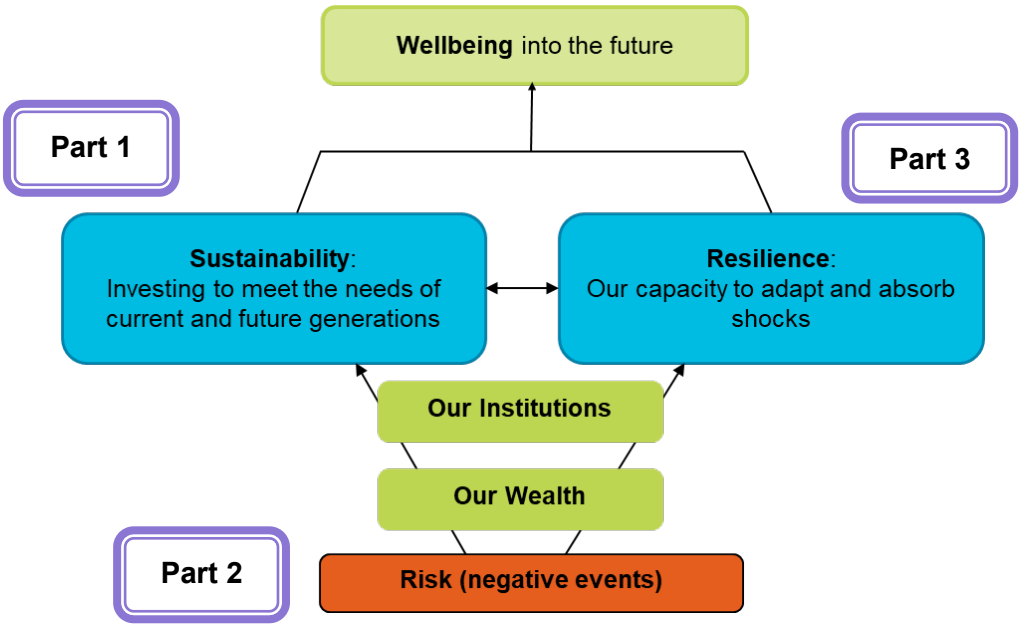
It summarises the available evidence – it does not attempt to generate new insights. While the Treasury has commissioned some new research in some areas, this paper mostly summarises what is known through the research of others. In doing so, it has focused on the key findings and our assessment of the current strength of the evidence overall.

It focuses on risks to future national wellbeing – it does not cover risks to the current wellbeing of individuals, communities or subgroups. While this paper does occasionally cover subgroups and consider shorter-term trends when they may have a major impact on wealth, most of the focus is national and mainly longer term. Therefore, it is important to read this paper in conjunction with the background paper *Trends in wellbeing in Aotearoa New Zealand: 2000-2020* (The Treasury, 2022c) and the forthcoming distribution background notes, which provide more disaggregated evidence and are also being released as part of Te Tai Waiora Wellbeing Report papers.

Our view of how risk, resilience and sustainability support future wellbeing

The future path of wellbeing is determined by three different but interlinked factors: sustainability, risk and resilience. There are multiple relationships between these factors, but Figure 3 conveys our view of how we think about the role of sustainability and resilience in supporting future wellbeing. It also shows what each part of the report is focused on.

Figure 3: Our future wellbeing will be shaped by how our wealth and institutions support resilience and sustainability



The ability of future generations to meet their wellbeing aspirations depends on both the sustainability of our current activities in terms of whether overall wealth is stable or increasing (allowing for population and productivity growth) and on how resilient we are or how well we can absorb and adapt to unexpected events.

These actions are key to both our sustainability and our resilience:

- ***Investing in the aspects of our wealth*** – they support both current and future wellbeing (for example, if we run down key infrastructure such as our roads, we may risk wellbeing in the future) and they also provide a buffer against risk (for example, higher levels of human capability better position people to adapt to an unemployment shock).

- ***Strengthening our institutions*** – they play an important role in facilitating the wellbeing of individuals and collectives, safeguarding and building our national wealth through good decision making, fostering innovation and productivity and responding effectively to emerging and crystallised risks (especially for unpredictable but high-impact risks).

While not shown in Figure 3, there are tensions and trade-offs between current and future wellbeing such as the extent to which we want to use or draw on aspects of our wealth to support current wellbeing relative to saving it for the future – which, among other things, builds resilience.

The structure of this report

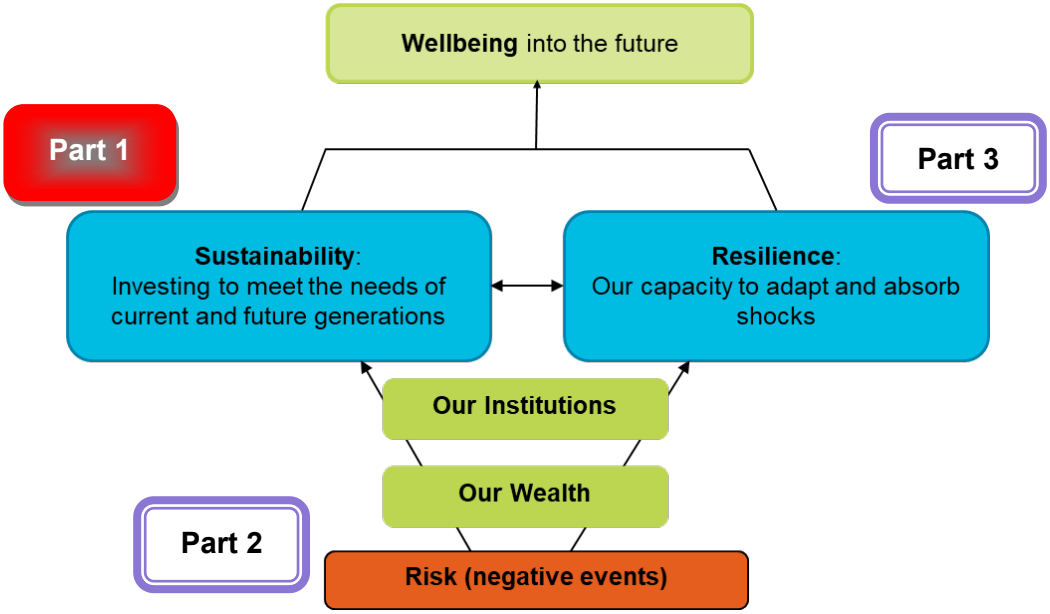
The interlinkages between sustainability, risk and resilience are complex and flow in all directions, but it is still useful to use these three concepts as the key organising structure for the paper.

The first issue is the **sustainability** of wellbeing. Part 1 of the report explores trends in the aspects of wealth in the Living Standards Framework and the ends in He Ara Waiora, which underpin wellbeing. If they are increasing overall, we are leaving the next generation with a larger pool of resources to support their wellbeing. On the other hand, if they are shrinking, the future is more likely to be characterised by generally lower wellbeing. In addition to the pool of resources, future wellbeing will also be enhanced if there are technological advances that enable wellbeing to be higher with the same resource use.

The second issue is whether there are **risks** that we can see on the horizon that would independently undermine the components of wealth and the ends – separately from the trajectory we have placed them on through our current activities. Part 2 of the report explicitly considers what risks might undermine wealth and wellbeing. These risks could mean that, even if we are increasing wealth and ends in aggregate now, our descendants may suffer lower wellbeing because of adverse events and shocks.

Finally, the extent to which the risks end up undermining wellbeing will depend on their impact. The level of the impact (or the extent to which people can adapt their wellbeing to their new circumstances) depends on the level of **resilience**. Creating resilience is often possible when it is not possible to avoid the risk altogether. This is also an area where Government, firms, iwi, households and individuals can make choices. Part 3 of the report considers the evidence about New Zealand's resilience and the key parameters that are important for enhancing it.

Part 1: Sustainability of wellbeing in the long run



Key messages about the sustainability of wellbeing

An important driver of our future wellbeing is the extent to which we are investing in, or drawing down, the wealth or resources that underpin wellbeing. One lens on sustainability is to assess whether the four aspects of wealth in the Treasury's Living Standards Framework are increasing or decreasing. Measuring how our national wealth is evolving could give insight into whether we are leaving future generations the resources they will need to sustain wellbeing.

At this stage, the overall trend in the relevant empirical measures is not robust enough to be definitive, largely because the valuation of our natural environment varies depending on the methodological differences between the World Bank and the United Nations. We have tentatively concluded that the measured value of our human and physical wealth has been increasing since 1995, and our social cohesion is high by international standards. The value of our natural environment has either slightly increased or slightly decreased, depending on how it is measured.

There are a range of threats to the sustainability of the natural environment, including the likely impact of climate change. In the past we, in Aotearoa New Zealand, have accepted a deteriorating natural environment as a price worth paying for improving wealth in other areas. But aspects of the natural environment are deteriorating, and the climate is changing, suggesting that our current way of life may not be sustainable. If this is the case, sustaining wellbeing will depend on whether technological innovation, productivity growth and societal choices will allow us to adapt. For example, sustaining wellbeing may depend on our ability to adapt to emitting less greenhouse gases and living in a warmer climate.

Aggregate measures are only part of the story, and in the risks section we look at individual aspects of our wealth to gain a better understanding of our strengths and weaknesses.

Sustainability is not easy to define

The most common definition of sustainability comes from the work of the Brundtland Commission of the United Nations in 1987:

> … the ability to meet the needs of the present without compromising the ability of the people living in the future to meet their own needs. (Brundtland, 1987)

There has been very extensive debate about this definition. It has been criticised as too vague, but more specific and formal definitions have not led to universal agreement either. Among economists, a common way of defining sustainability more specifically is to say that current levels of wellbeing in an economy are sustainable only if the total wealth of that economy is not decreasing (after allowing for productivity and population growth).

What people do agree on is that intergenerational equity is central as a motivating principle for the study of sustainability. Safeguarding the aspects of our wealth against deterioration is one of the most important things we can do to maximise the chances that future generations will be able to enjoy the same overall wellbeing as we do currently, which is a value held in many world views and ethical traditions.

The concept of sustainability is captured within He Ara Waiora through **Mana Whanake**, the power to grow sustainable, intergenerational prosperity. Thinking across generations is a feature of Māori enterprises. The gains being made by the Māori economy act as a vehicle for improving wellbeing, both now and into the future. Many Māori businesses operate on a multiple bottom line, which includes sustainability and intergenerational outcomes.

> One of the key deficiencies in this section is that we have had to largely rely on overseas calculations measuring the aspects of New Zealand's wealth in the Living Standards Framework.
>
> Right now, we do not have equivalent research to assess whether we are achieving overall sustainability against the Ends in He Ara Waiora.
>
> The background paper on Māori wellbeing covers the available information in more detail.

This report considers whether as a nation New Zealand is on a sustainable wellbeing path, considering all the aspects of wealth together. This paper does not consider in detail whether there are subregions or particular parts of our activities (like fishing or agriculture) that may be showing trend declines in certain types of wealth or capital considered in isolation. A paper on the natural environment looks at natural capital at a more disaggregated level (NZIER, 2022).

This paper is also focused on whether the current level of wellbeing overall is sustainable. It is not based on an assumption that all aspects of our way of life will remain unchanged. For example, it is clear that, under our climate change commitments, current levels of oil and gas usage need to fall, but while reducing our current use may change the way we live our lives, it may or may not reduce wellbeing depending on whether those in the future can adapt to this new way of life, including through changes in the structure of the economy.

Substitutability between the four aspects of wealth and sustainability

Our review of the evidence suggests that measuring the sustainability of wellbeing is still in its infancy. One of the key unresolved questions is the extent to which the components of wealth are substitutable for each other. The degree to which they are substitutable is at the heart of the debate between weak and strong sustainability.

Under weak sustainability, the components of wealth are viewed as largely substitutable, and what matters is whether the sum of all the aspects of wealth is changing.

If the components of wealth can be substituted for each other, the diminution of one wealth can be offset by the growth in another such that the sustainability question is whether the overall effect on wealth, and hence wellbeing, is positive or negative. In some cases, increasing one wealth helps build another. For instance, economic growth builds physical and financial wealth but there is also a clear positive relationship between economic growth and higher human wealth (both in higher education and better health) and higher social cohesion, including stronger institutions (Galor, 2022).

The belief that some aspects are non-substitutable underpins the strong sustainability viewpoint.[1] If one or more components of wealth are not substitutable or are complements to other components (they are critical to support wellbeing), we also need to understand what is happening to those non-substitutable aspects of wealth.[2]

The natural environment perhaps provides the clearest examples where some aspects of wealth are not substitutable or that certain types of natural capital cannot be depleted even if that would facilitate growth in other wealth. Sometimes, strong sustainability criteria are associated with the idea of critical limits or tipping points for which there is no possible substitution through other capitals. Crossing these would mean that future wellbeing is forever compromised.

What might determine whether the different wealth can be substituted

The degree to which – or indeed whether – the decline in one wealth can effectively and cost-effectively be substituted by the growth in the others is likely to be dependent on the precise circumstances and what particular components of wealth one is talking about. This issue is still under intense debate, and evidence gathering continues (Cohen et al., 2019).

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1 The OECD Glossary of Statistical terms defines strong sustainability as: "All forms of capital must be maintained intact independent of one another. The implicit assumption is that different forms of capital are mainly complementary; that is, all forms are generally necessary for any form to be of value. Produced capital used in harvesting and processing timber, for example, is of no value in the absence of stocks of timber to harvest. Only by maintaining both natural and produced capital stocks intact can non-declining income be assured." https://stats.oecd.org/glossary/detail.asp?ID=6577

2 The OECD Glossary of Statistical Terms defines weak sustainability as: "All forms of capital are more or less substitutes for one another; no regard has to be given to the composition of the stock of capital. Weak sustainability allows for the depletion or degradation of natural resources, so long as such depletion is offset by increases in the stocks of other forms of capital (for example, by investing royalties from depleting mineral reserves in factories)." https://stats.oecd.org/glossary/detail.asp?ID=6611

For example, local conditions, including cost and timeframe considerations, may mean that the degree of practical substitutability is so low that the weak sustainability criterion does not make sense and a strong sustainability criterion would be simpler and more attuned to local circumstances. Societies can also choose a strong sustainability approach in certain cases on ethical grounds – for example, where unique or taonga species or landscapes are concerned.

Finally, different societies will have different views on how to balance any trade-offs between drawing down wealth to address current wellbeing issues versus investing in the different aspects of wealth to support future wellbeing. One analysis of a larger list of planetary and social indicators found that no country meets basic needs for its citizens at a globally sustainable level of resource use and the countries that achieved more highly on social goals crossed a greater number of biophysical boundaries (O'Neill et al., 2018). This study's finding that no country met both the social and biophysical goals suggests that the current technological frontier imposes some hard decisions between maintaining the natural environment and current wellbeing.

The strong sustainability approach is closer to how the environment is treated in He Ara Waiora. In te ao Māori, the wellbeing of Te Taiao is inextricably linked with the wellbeing of people. Humans are linked by whakapapa with other living beings and natural elements. We are in a relationship with the environment that needs to be kept in balance, meaning that caring for the environment is an intrinsic cultural value and an obligation. Adverse impacts upon the environment create risks to human wellbeing. Obviously, for example, we rely on the natural world to provide our life support systems such as clean air, safe drinking water, nutrient cycling and other processes that require biosphere integrity at some minimum scale.

Māori identity is created in large part by connection to whenua and waterways – when the mauri (life force) is detrimentally affected, this flows through to impacts on people. Detrimental impacts on mahinga kai (food gathering places) also affect the mana of the iwi, for example. Similarly, if a taonga species were to become extinct, this would have astrong detrimental effect. Such an event may become a matter of shame for a broad range of New Zealanders.

Negative impacts on Te Taiao create risks to the generation of sustainable, intergenerational wealth given that much of Aotearoa's economy is based on primary industries. This is particularly true of Māori incorporations that are land-based and often hapū or whānau-level enterprises. They are vulnerable to changing weather patterns as a result of climate change.

Evidence about sustainability of wellbeing in New Zealand

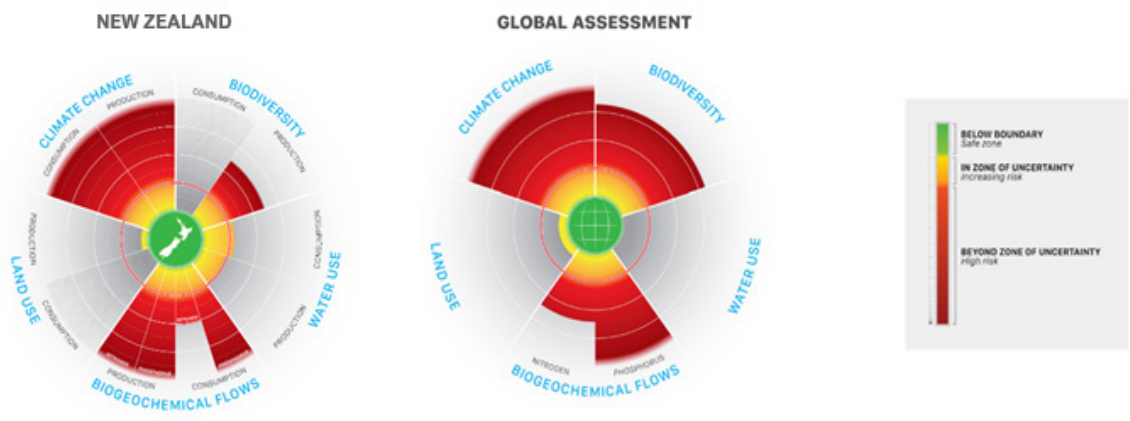
The accumulating evidence that there are adverse consequences if biophysical thresholds are breached has been one of the main forces driving the increased salience of strong sustainability as a metric in many cases. At the global scale, it is associated with work on planetary boundaries. The key concept for that work is that there are environmental boundaries that it would be "deleterious or even catastrophic if crossed due to the risk of crossing thresholds that will trigger non-linear, abrupt environmental change within continental-scale to planetary-scale systems" (Rockström et al., 2009). The Stockholm Resilience Centre is one of the primary proponents of this approach. While its nine boundaries do not represent an official internationally adopted framework, it currently has the most coherent framework for assessing these limits at a global level, which has informed the discussions around the UN Sustainable Development Goals.

The Ministry for the Environment commissioned the Stockholm Resilience Centre to assess New Zealand's performance against five of the nine key planetary boundaries – climate change, land use change, freshwater use, biogeochemical cycles (nitrogen and phosphorus use) and biosphere integrity (related to biodiversity).[3] These five were selected because they were thought suitable for using on a national scale and because there was adequate data to measure them.

The report (Anderson et al., 2020) assessed New Zealand's performance using both the amount we produce and the amount we consume. In each case, the analysis looked at the equal per capita-based fair share – the nation's allocation based on the size of New Zealand's population relative to the world's population.

The overall results are shown in Figure 4. The report states all five boundaries are breached, but closer inspection reveals two of those are in a zone of uncertainty, so there were three definite breaches (climate change, biodiversity and biogeochemical flows) plus two possible breaches (land use and water use).

Figure 4: New Zealand's assessment against planetary boundaries



Source: Anderson et al., 2020, pp. 7 and 41.

The report notes New Zealand is also at risk from the global impacts of the world's position relative to the other four planetary boundaries. Assessed globally, ocean acidification and ozone depletion are currently both within the planetary boundary. Novel entities (for example, synthetic organic pollutants, radioactive materials and micro-plastics) and aerosol loading have currently no global quantification to enable the use level to be assessed.

Issues with the planetary boundaries approach

There is general agreement that there are planetary boundaries that, if crossed, would damage the wellbeing of future generations. There is also widespread support for the use of the precautionary principle that, where there are threats of serious or irreversible damage, the lack of scientific evidence should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

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3 Those not assessed were novel entities, ocean acidification, aerosol loading and ozone depletion.

However, these concepts are easier to state than to assess, and this has been a key critique of the Stockholm approach (Biermann & Kim, 2020). A recent survey described them as "nascent" (O'Neill et al., 2018) or a "problematic" if useful concept (Dasgupta, 2021). This is largely because, at our current state of knowledge, there is considerable uncertainty both around where the boundaries lie and to understand the extent to which complex interactions in nature builds resilience to them (Rietkerk et al., 2021). The Stockholm Resilience Centre has also clarified that their current boundaries do not represent critical "tipping points" (Rockström et al., 2017).

Not all the boundaries are equally uncertain especially when considered on a global scale. Some, notably ozone and carbon dioxide levels, have reasonably strong scientific support, but others, notably the biodiversity, water use and land use boundaries, have much lower levels of scientific research behind them with scientists advocating for both higher and lower limits.

There is also uncertainty in some cases about the impact of approaching or hitting the boundary. In some cases, the consequences are clear even if the boundary is not, while in others, the consequences are much less certain.

> *The idea of planetary boundaries has powerful heuristic appeal and has excited the public's imagination of the processes that govern the Earth System. It may have proved to be a problematic concept, but it is a useful classification of the Earth System's biogeochemical processes.*
>
> Dasgupta, 2021, p. 108

Finally, there is also lack of consensus about how to turn global limits into national or subnational limits. Even once the global limit is well defined, the approach used in the New Zealand report of distributing these by the proportion of the world population does not seem to accord well with ensuring scarce resources are used most effectively for global living standards into the future, nor does it address whether, in a particular sub-global area, mitigation or adaptation is the most cost-effective approach at the margin.

We expect that there will be future refinements of this approach in the coming years and that these will clarify the extent to which the capitals are able to be substituted and bring greater clarity to where key planetary boundaries lie.

Measuring the trajectory of our total wealth

Many organisations have attempted to measure overall sustainability using various different metrics and methodology. This reflects that, currently, there is not a single generally agreed approach. For this reason, we have focused on the measures used by the World Bank and the United Nations and also looked at New Zealand's performance using the genuine progress indicator methodology.

How is comprehensive wealth measured?

This paper cites two cross-country measures of comprehensive wealth from the World Bank and the United Nations Environment Programme (UNEP). The two measures show different results for New Zealand, so it is important to understand why. Appendix A provides a longer explanation of the methodology used by each institution.

While there are many small differences, the ones that explain the most of difference in outcomes are:

- the UNEP links the weight of each capital to the marginal impact of an additional unit in the future, whereas the World Bank uses the System of National Accounts (SNA) and associated System of Environmental-Economic Accounting (SEEA) approach that looks at the value that the assets could be exchanged for in cash
- the UNEP covers a wider range of natural capital services (for example, pollination, air quality regulation and genetic diversity), whereas the World Bank has only included a more limited set captured in the SNA and SEEA.

These differences result in a marked difference in the weighting of the four aspects of New Zealand's wealth. In the World Bank measure, natural capital is about 10% of the comprehensive wealth, whereas in the UNEP it is about 70%. As the natural capital trajectory has been flat or negative while human and physical/financial capital has been more positive in both measures, this difference in weighting drives the overall outcome.

These differences are material. The UN aggregate wealth measure shows a trend fall, while the World Bank's measure is on a trend rise. This illustrates the importance of the fact that the methodology for measuring comprehensive wealth is still under development. It is not at the stage where we can confidently rely on any single one of these measures as an overall indicator of sustainability.

World Bank's comprehensive wealth

The World Bank bases its assessment of sustainability on a measure called comprehensive wealth,[4] which is conceptually the same as the stock of total wealth. This measures whether a country is saving by adding to its stock of comprehensive wealth once all types of depreciation have been accounted for, including any decline in the natural environment.

If a country's comprehensive wealth per capita is increasing, those in the future will have more wealth to support their wellbeing. This will mean that the next generation will have higher resource pools available to support their wellbeing (barring major adverse shocks, which are covered in the next section). On the other hand, if it is declining, the next generation is more likely to have lower wellbeing living standards. In addition to the pool of resources, future wellbeing will also be enhanced if there are technological advances or productivity growth that enable wellbeing to be higher with the same resource use.

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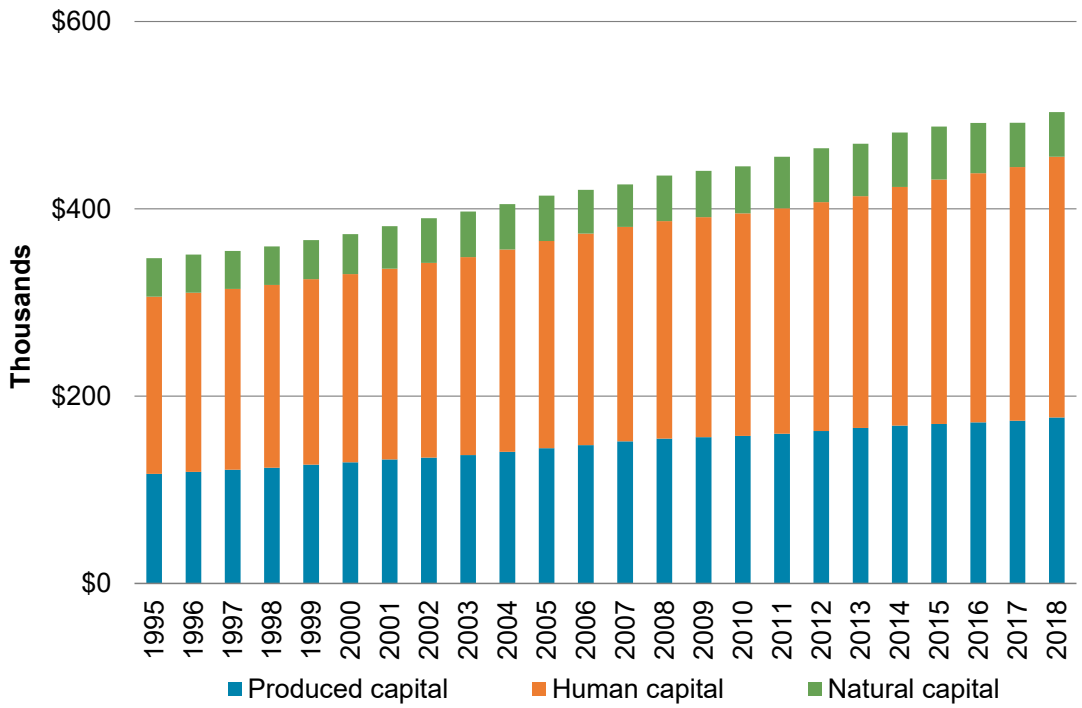
4 Similar concepts are called genuine savings, adjusted net savings and comprehensive investment and as the change in comprehensive wealth.

Research suggests that the World Bank's comprehensive wealth metric has some predictive power for living standards growth in the recent past. Further research on the long-run growth in the United States, United Kingdom and Germany shows that it is predictive of longer lives, better health and higher education, incomes and overall life satisfaction over generations, though it performed less well in predicting living standards growth in Sweden (Hanley et al., 2016; Markandya & Pedroso-Galinato, 2007; World Bank, 2021).

The World Bank calculates that the change in New Zealand's comprehensive wealth has been positive since it began publishing in 2000, and while we do not have the highest level of comprehensive wealth per capita among countries, we are also well above the OECD average and many of our normal comparator countries (Figure 5).

Figure 5: New Zealand's comprehensive wealth per capita (in real 2018 US dollars)



Source: World Bank, direct communication, 30 Aug and 07 Sept 2022 (produced capital and natural capital); Trinh Le direct communication, 30 August 2022 (human capital). There are minor differences between the two sources in the handling of inflation and the exchange rate

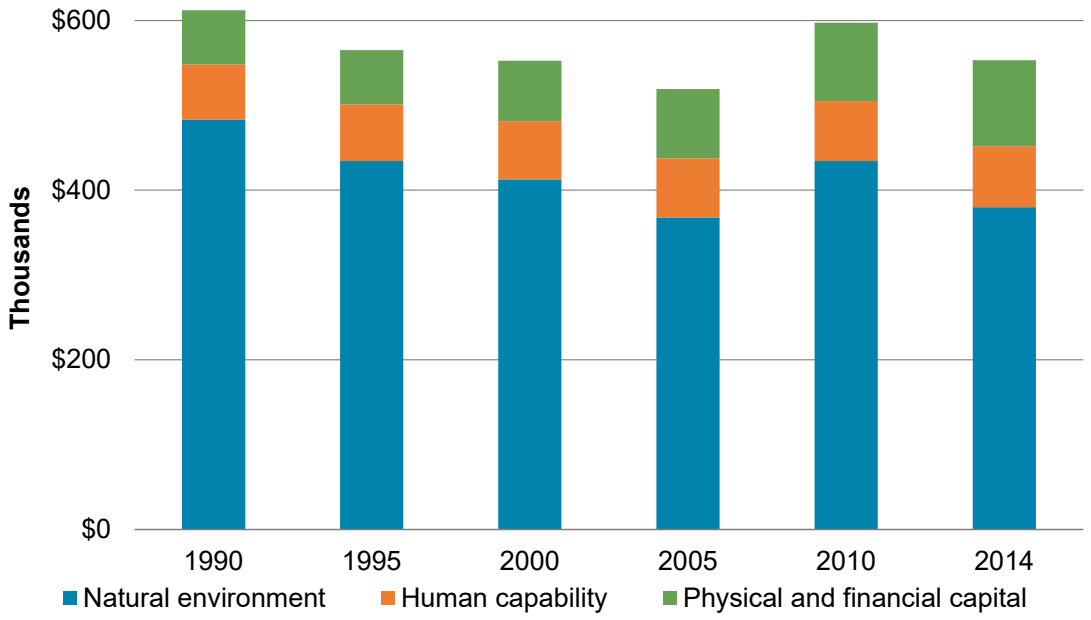
The Treasury commissioned research on longer-term changes in comprehensive wealth[5] using several alternative methods (Qasim et al., 2018). This took our comprehensive wealth calculations back to 1950, over which time New Zealand's comprehensive wealth growth rate was between 5% and 20% every year (depending on the particular measures used). This finding suggests that there has been a long-term consistent pattern of increasing total wealth available for future wellbeing.

5 At the time this report was written, the World Bank's core measure was called genuine savings rather than comprehensive wealth.

United Nations' inclusive wealth

In contrast to the above measures, the United Nations' inclusive wealth measures suggest that New Zealand's wellbeing has on average not been sustainable over the period since 1990 because inclusive wealth has declined between 1990 and 2014[6] (Figure 6). Like the World Bank, this measures the value of human, physical and natural wealth. The decline since 1990 in New Zealand's inclusive wealth is because the value of natural wealth has declined, and although both human and produced wealth have increased, their measures of these are small and so they were not able to offset the trend decline in natural wealth. Declining natural wealth is even more concerning if its substitutability is diminishing.

Figure 6: New Zealand's inclusive wealth 1990-2014 per capita (in real 2005 US dollars)



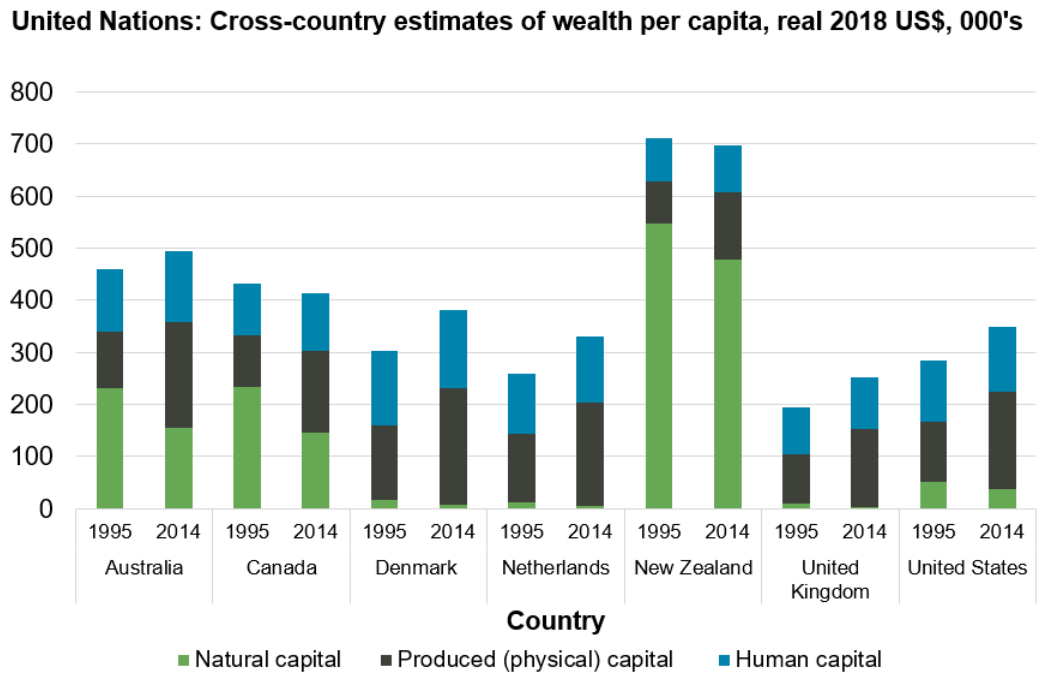
Source: United Nations Environment Programme (2018), using Living Standards Framework language for the equivalent capitals.

New Zealand's performance in an international context

Figure 7 and Figure 8 show how New Zealand stands relative to small group of high-income countries. These graphs show the very large difference in natural capital value per capita between the two measures – sufficient to heavily influence the assessment of whether aggregate wealth is increasing (World Bank) or decreasing (United Nations) – appears largely due to the differing treatment of forested land as a source of benefits other than harvested timber. There are differences in what is counted in such benefits, as well as in their respective valuation philosophies, as noted in the box above.

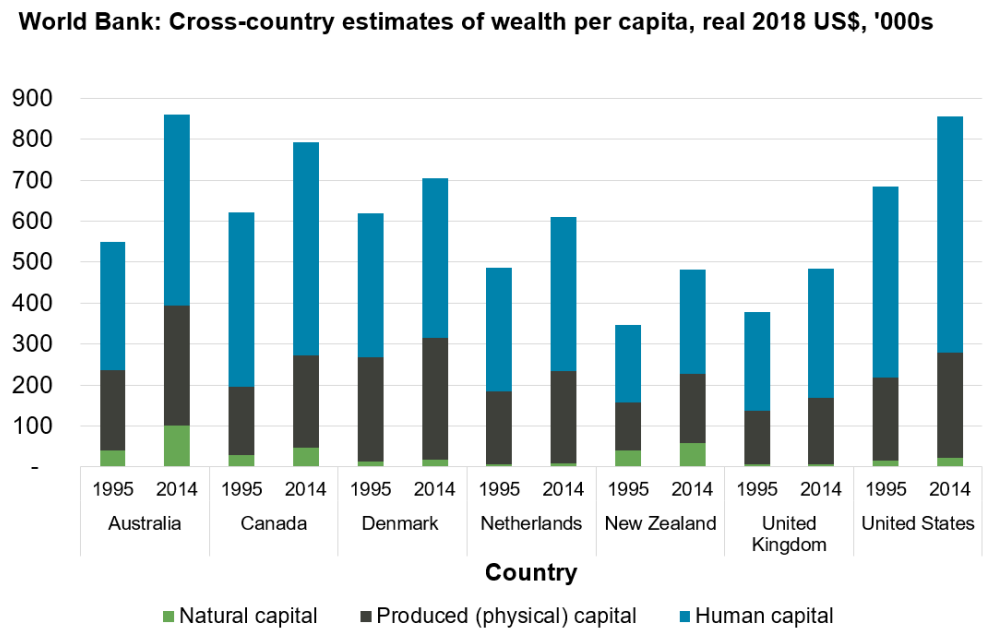
6 2014 is the most recent year available in the UN inclusive wealth report.

Figure 7: The United Nations measures suggest that Aotearoa New Zealand's total wealth is declining reflecting their lower natural capital values



Source: United Nations, 2018.

Figure 8: The World Bank measures suggest Aotearoa New Zealand's total wealth is increasing because of growth in physical and human capital



Source: World Bank, 2021 (produced and natural capital), direct communication; human capital, Le, 2022.

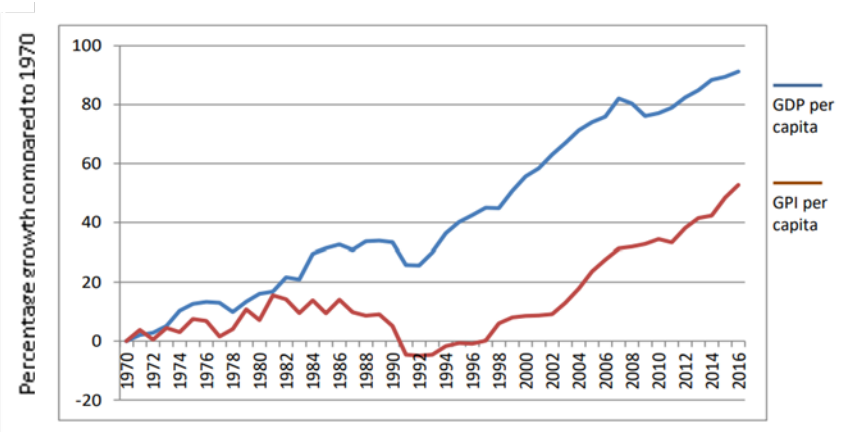
The extent of the difference is sufficiently large that it suggests that it would be inappropriate to place much weight on either one as a robust measure of the aggregate level of wealth. However, each agency has consistently used its methodology to measure changes since 1995. In our view, this means that the trends may be more reliable even though there is a large difference in the measured level. As a result, we can with some confidence conclude that:

- the value of our human capability and physical capital is increasing, at rates similar to those in developed countries shown in Figure 7 and Figure 8
- the measured value of our natural environment is either slightly increasing or decreasing, depending on how it is measured.

The genuine progress indicator

There is one final measure that is related to, but not the same as, the change in comprehensive wealth or genuine savings. The genuine progress indicator (GPI) measures the equivalent of GDP after all the impacts of cost externalities, undesirable impacts, inequality and intergenerational equity are taken into account (Patterson et al., 2019). While it is not looking explicitly at the impact on the four aspects of wealth, this alternative measure is motivated by a similar question of whether we have the resources available to add to our total wealth if we choose to. This measure suggests that, except for the early 1990s, New Zealand has generally had a rising GPI per capita and that this was growing particularly strongly over the first decades of the 21st century (Figure 9). The three leading reasons for this growth were the rise in personal consumption per capita, the value of household and community work and the value of public services. On the other hand, the costs that increased most were the rise in income inequality, the cost of congestion and the rise in the number of people working more than 50 hours a week.

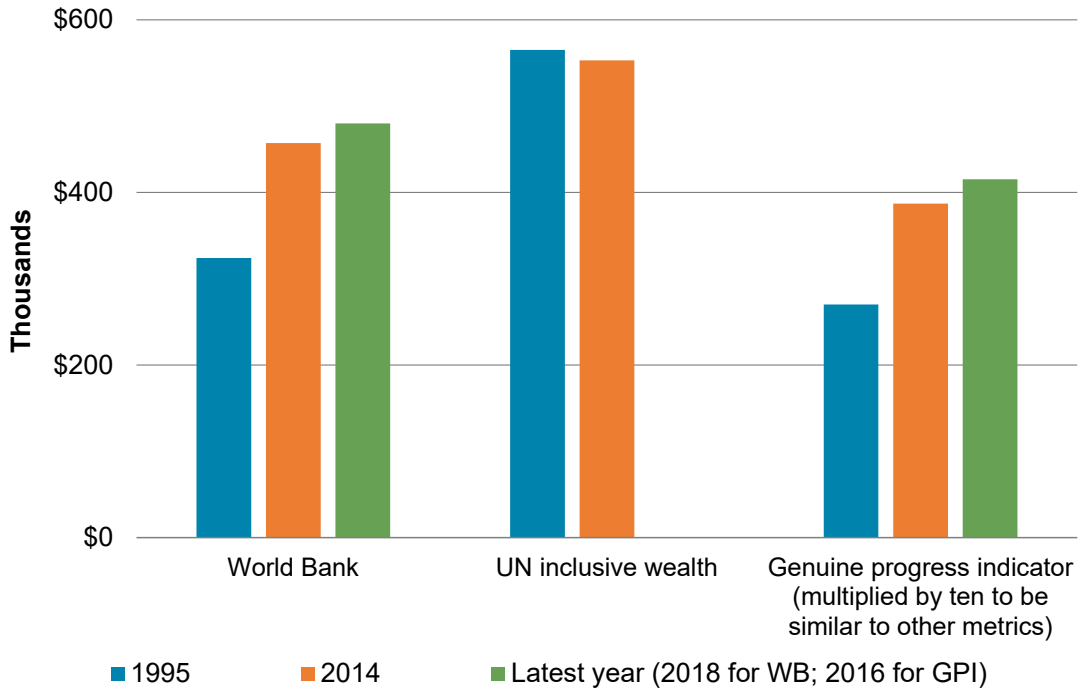
Figure 9: The GPI and GDP, real per capita percentage change 1970 to 2016



Source: Patterson et al., 2019, p. i.

Figure 10 shows the overall change from 1995 onwards across the three different metrics.

Figure 10: Change in weak sustainability capital measures, 1995 to latest year (in US dollars, 2018 for the World Bank and 2014 for the UN)



Source: World Bank, direct communications, 30 Aug to 7 Sept 2022 (produced capital and natural capital); Trinh Le direct communication, 30 August 2022 (human capital); United Nations Environment Programme (2018), using Living Standards Framework language for the equivalent capitals Patterson et al., 2019, p. i.

We conclude that the empirical measures are not at a stage of robustness that would enable us to definitively state that our wellbeing is either sustainable or unsustainable. We can conclude with reasonable certainty that our measured value of human and physical wealth has increased since 1995, but our natural environment wealth has either slightly increased or slightly decreased, depending on how it is measured. This suggests that our current way of life may not be sustainable, particularly if we are close to planetary limits, for which there is also some evidence. If this is the case, future wellbeing will depend on whether technological innovation, productivity growth and societal choices will allow us to adapt to these challenges.

The changing relationship between resource use and economic growth

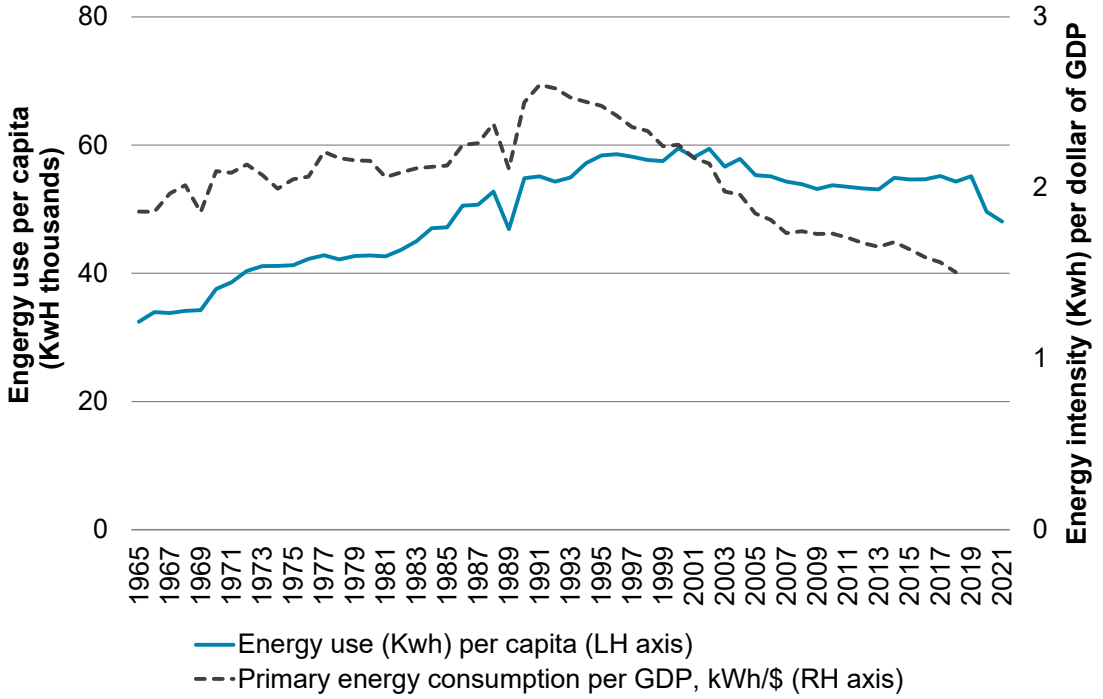
One key influence on the judgement of whether New Zealand is on a sustainable path is to look at how efficiently we use our resources to produce a unit of output, including the environmental impacts of production activities. Such efficiency is an aspect of technological and productivity improvement, which includes increases in the substitutability of different forms of capital. On the metrics shown in Figure 11 and Figure 13, it looks like we have become better at using fewer resources to support the same level of output, though if we then increase output, that could offset this gain in terms of net demand on resources and pressure on the environment. Using resources more efficiently reduces the impact on the natural environment, but it does not mean that we are not running down key stocks. It does, however, perhaps reweight the focus towards the level of misuse such as pollution and other externalities. Many of

the Living Standards Framework Dashboard metrics for the natural environment focus on areas where there are concerns about misuse such as pollution rather than measuring the overall level of the natural environment. These are most relevant to the planetary boundary discussion above.

During the 19th and 20th centuries, there was a tight relationship between economic growth and the amount of energy consumed. However, since about 1970, this relationship has weakened, especially in high-income countries. In New Zealand, the energy required to produce GDP has been falling since 1990,[7] and as shown by Figure 11, New Zealand's energy consumption as a proportion of GDP has now been consistently lower than 1965 levels for over a decade. Even energy use per capita has been falling, and (ignoring the unusual dip due to COVID-19) it is now back to the levels last seen in the late 1980s.

There are many reasons behind the disconnect between GDP and energy use, including the rise in the service sector and decline in manufacturing, growth in renewable energy, which was 37% of total energy usage in 2022,[8] the move towards recycling and the marked rise in technological efficiencies particularly, but not only, due to information technology.

Figure 11: Primary energy consumption (in kilowatt-hours) per unit of GDP (in 2011 real dollars)



Source: https://ourworldindata.org/grapher/energy-intensity?tab=chart&country=~NZL; https://ourworldindata.org/grapher/per-capita-energy-stacked?time=1989&country=~NZL

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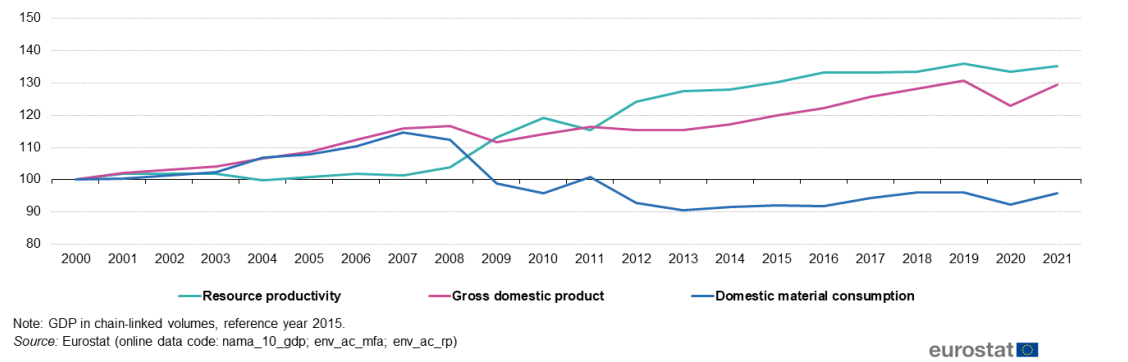
7 This was dropping in most comparator countries from about 1970, in part due to the high oil prices of that decade. New Zealand's energy intensity continued through this period and the 1980s despite the high prices, possibly because industry policy promoted large-scale factories, particularly those based on gas.

8 Our World in Data, calculated from the *Statistical Review of World Energy* (BP, 2021).

But in the 21st century another trend is emerging – the more-efficient use of resources beyond energy as a result of wider technological innovation. Countries with material flow accounts, which measure the tonnage used and produced in GDP, have found that there has been a disconnect between total resource use and GDP growth, particularly in the inputs used for both agriculture and manufacturing (OECD, 2008). This is not because the use of resources has been shifted to other countries (such as China) as the material flow accounts measure the resource use in consumption (production plus imports minus exports) not production.

The result has been a rise in resource productivity – an increase in the value of GDP that is achieved from a unit of all resources used as inputs (Eurostat, 2022). This resource productivity has become significantly more pronounced in many countries after 2010, particularly high-income countries such as the USA and the European Union (Figure 12). This has been so pronounced that the material used for consumption has declined in total volume as well as the ratio to the (still rising) level of GDP. (A fuller exposition can be found in McAfee, 2019.)

Figure 12: Development of resource productivity in comparison with GDP and domestic material consumption, EU 2000-2021 (2000 = 100)



Note: Domestic material consumption includes materials produced in the country plus imports but excludes materials used in exports. Source: Development_of_resource_productivity_in_comparison_with_GDP_and_DMC,_EU,2000-21.png (1338×530) (europa.eu)

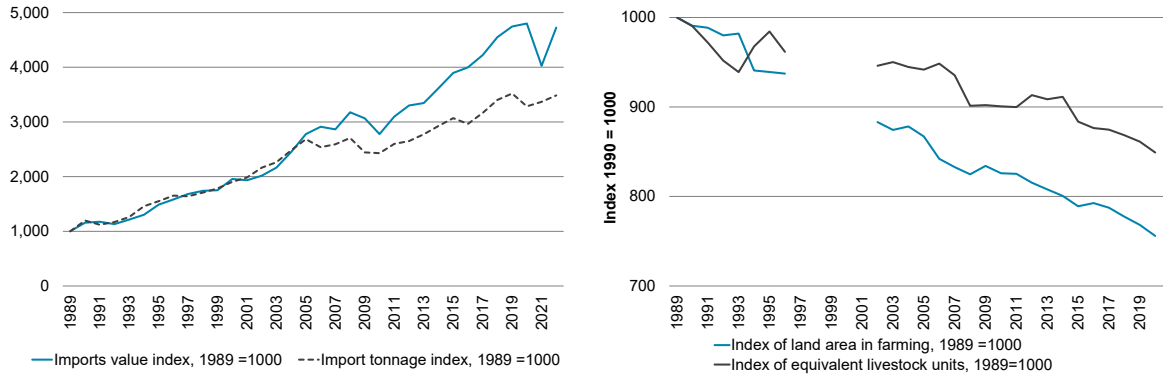
The fall in material resource use has been accompanied in some countries by a decline in damage to the environment as measured by the available proxies of air pollution and carbon dioxide emissions. For instance, the damage-to-output ratio in the USA declined from about 10% in 1998 to 6% in 2018. While the performance of individual countries has been variable, most high-income countries have shown a similar decline. The aggregate world numbers have also fallen, though by less because middle- and low-income countries have had little change in their damage-to-output ratio (Mohan et al., 2020).

New Zealand does not have a comprehensive set of material flow accounts, but it does have statistics on some key inputs into some significant sectors. These hint that New Zealand has also participated in the decoupling of the quantity of resources required to support a high standard of living:

- The long-term relationship between value of the goods imported and its tonnage (as an indication of the material resources embedded in them) has disconnected since the mid-2000s (Figure 13).

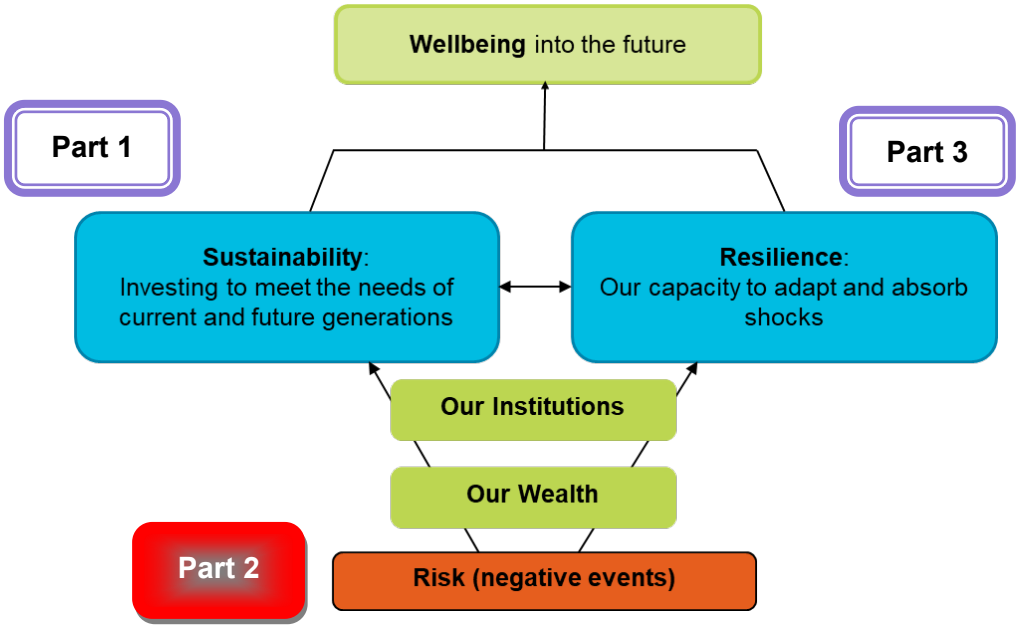
- The increased volume of our agricultural exports has been created using a lower level of some inputs from our natural environment. As Figure 13 shows, agricultural production is post peak farmland area (1990, now 75% of the maximum), peak livestock unit (1986, 80%) and peak fertiliser (1980, 60% by tonnage). Most of the released farmland has gone into forestry and reversion to nature while the accompanying intensification of the remaining land has had an impact on water use and quality, though some of this is also climatic (Snelder et al., 2022).

Figure 13: Indicators of the intensity of material resource intensity in New Zealand, 1989-2020



Source: Calculated from Stats NZ OSC008AA, SNE114AA and AGR001AA.

Part 2: Risks to our wellbeing



Key messages about risks to New Zealand's wellbeing

In some ways, New Zealand's risk profile is like other high-income countries, but our risk profile is different in important ways, and we also have some key negative trends that increase risks in the future.

Like other high-income countries, New Zealand has a higher level of economic risk but a lower level of risk to life and health. This means that, when a risk event occurs, it has a high impact on physical and financial assets and a comparatively low level of death and disability.

New Zealand has benefited from the international trend towards a lower-risk world. We have:

- a decline in the risk of dying or being disabled from avoidable causes
- a rise in skill levels, which increases both the ability of our country and of individuals to adapt to change
- less economic volatility due to the growth of the service sector and more-stable monetary and fiscal policy, including a floating exchange rate, which mitigates the impact of economic fluctuations overseas.

New Zealand has a unique risk profile from our natural environment, where we have more exposure to high-impact, inevitable but rare events (HIREs). Events such as earthquakes, tsunamis and volcanic eruptions are difficult to predict and impossible to control. In addition, New Zealand, like the rest of the world, faces the risks associated with climate change.

We are also experiencing some changes that pose risks for the future:

- Our PISA scores have been falling, and between 15% and 20% of youth and adults have a level of skills that the OECD considers puts them at risk of failing to achieve in the modern world.
- While our deaths from avoidable causes have dropped, our risks are increasingly focused on lifestyle choices, and these are complex to address.

The trends in our wealth does not capture risks

Both the strong and weak sustainability assessments assume that the future will be an outcome of the wealth trends that are already apparent, but there are many events that could drive wellbeing from this path, and in New Zealand's case, the risk that this may happen is not trivial. We are going to focus on the risks that are sufficiently major that they could do so by undermining our stock of wealth.

There is, however, one major risk that we only touch on lightly – the impact of climate change. This has already been considered in the discussion on planetary limits, and we recognise that this is a major, pervasive, clear and present risk that could undermine many aspects of our wealth and therefore wellbeing, but we are aware that it has been covered extensively elsewhere, both internationally[9] and in New Zealand (for example, NZIER, 2018).

In many aspects of life, there are unexpected events. Sometimes, they result in outcomes that are better than expected. Other times, they are worse. The variability of outcomes is inherent in the concept of risk, particularly variability that is negative.

But variation can also be beneficial. Many of the changes that have improved lives have come with the risk of failure, and without taking that risk, we would not have had the upside. This is most clearly seen with business risk, but it is also true in areas like research and development.

As this background paper has been written to support the legislative requirement that Te Tai Waiora Wellbeing Report must describe "any risk to the state of wellbeing in New Zealand", we have interpreted this to mean that the focus is on the risk that wellbeing will be impacted negatively.

However, while this paper focuses on the negative risk events and how to reduce their impact on wellbeing, it is important that society is willing to tolerate appropriate risks so that we get the rewards that taking them can bring to wellbeing. What is tolerable will vary depending on people's risk profile, and so it is something that is subjective rather than something that can be determined absolutely. Sometimes, it is also a choice that is made – to live with the risk because it would be more expensive to avoid it – and avoiding all risks completely is likely to be prohibitively expensive. This paper does not define either the optimum risk profile or the best reaction as those are issues for society to determine.

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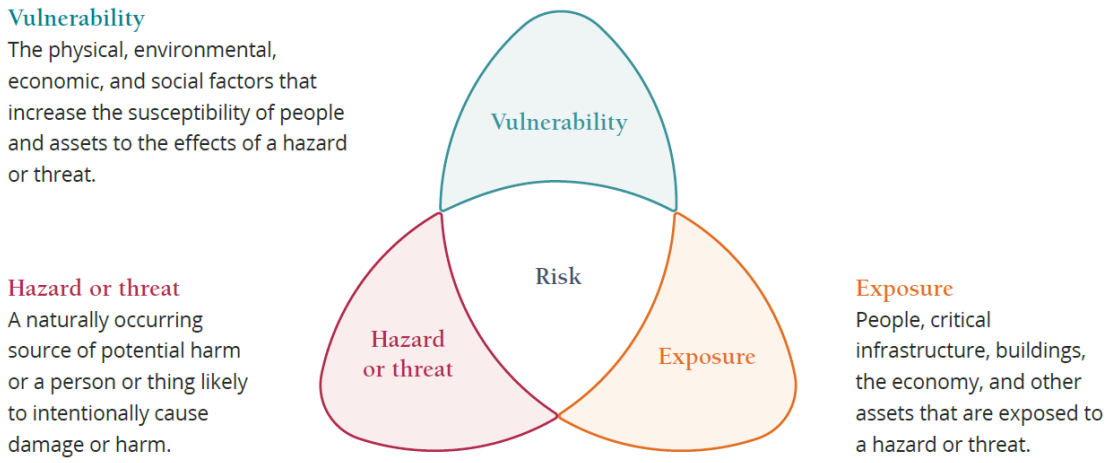
9 See https://www.ipcc.ch/reports/

Risks – the roles of frequency, severity and impact

The risks we are concerned about are those that have a major impact on wellbeing. This means the focus is not just on the existence of a hazard but also the extent of exposure and the level of vulnerability of the population to a negative outcome (Figure 14).

Figure 14: The dimensions of risk



Source: Department of the Prime Minister and Cabinet. [Unpublished].

Hazards come in two different types. The first type is the impact of a sudden, negative event that is often difficult to predict (**sudden risks**). An earthquake or a pandemic are examples of a sudden risk. The second type are not events but rather the result of current trends that reduce wellbeing over time (**slow-onset risks**). These are often a trajectory of gradual decline rather than something that happens suddenly. Steadily increasing pollution levels is one possible example of a slow-onset risk that has a cumulative impact over time.

Both types of risk can undermine future wellbeing. To keep this paper manageable, it will only consider the risks that would have a large negative impact on national wellbeing.

The role of predictability and severity

Not all risks are the same, and the key features that differentiate them are their predictability and level of impact. Predictability is determined by the degree of certainty around if and when the risk will happen (particularly sudden risks), or it can be the predictabilty of the type and severity of the impact when it does (which can apply to both sudden and slow-onset events).

Risks are generally split into three different kinds, depending on their likelihood of occuring and expected severity:

- **Normal risks:** These are reasonably predictable, both in their timing and impact. This higher level of certainty means that it is possible to develop systems that people, firms and the country can put in place to address them such as insurance or building flood banks.

  Uncertain or HIRE risks: These may have known probability of happening but they are so infrequent that people do not know when they will come or have the experience to judge their likely impact. An example is the Wellington fault line, which is known to have a major earthquake every 500–1,000 years, but this does not tell us when the next one will happen or how much damage it will do. When the impact is uncertain, it is more difficult to prepare a specific plan, so it is often more effective to have a wider approach that can cover multiple possible scenarios. (Gluckman and Bardsley (2021) have a more-detailed review of these in the context of New Zealand.) HIRE risks are more often subject to the cognitive bias of "it won't happen to me". Experience suggests that individuals and firms underinvest in preparation for these infrequent events before they happen and that societies tend to over-react when they have. This may be because people become significantly more risk averse immediately after a major negative event but this declines over time (Schildberg-Hörisch, 2018).

- **'Black swans' or unknown unknowns:**[10] This is when a large-impact event happens that is completely unexpected or so very little expected that it is a surprise. The term is also used when an event turns into a risk because it has unexpected negative outcomes. If you don't anticipate a risk, it is impossible to prepare for it. The OECD suggests that, for these events "crisis management plans, while fundamental, are not enough" (OECD, 2017, p. 12). Resilience to these risks is then dependent on the generic settings – having good decision-making frameworks that can adapt to the unexpected and adequate available resources, which can be easily repurposed for whatever is required (Kay & King, 2020).

It is easier and there are more options for building resilience to normal risks than HIRE risks, and in turn, HIRE risks are easier than black swans. This means that additional information or preparation that moves a risk into a more certain category has the potential to increase resilience. However, HIREs and black swans will always exist, so there will always be a need for a mix of responses.

[10] The literature draws a distinction between risk, where a distribution can be reasonably accurately discerned with enough experience, and uncertainty, where there is little or no ability to discern the distribution of the event.

Richer societies face a different mix of risks

All societies and individuals make choices about which risks they are willing to pay to avoid. As countries become wealthier, they have more resources for households, local authorities and government to use for this purpose.

Reducing risks can be costly. Investing in more-robust systems often takes extra money to build better (for instance, building codes or flood protection systems) or to incorporate redundancy in critical systems (for instance, key utilities like electricity supply). It can also mean choosing not to do desirable activities in potential at-risk areas or activities (for instance, the red zone in Christchurch or building on flood plains).

Making the case for spending on reducing risk is easier when the risk occurs frequently and the impacts are reasonably well known (such as areas of repeated flooding). It is less easy to make the case for infrequent events that may not happen in the lifetime of those paying the cost, and it is even harder when the likely impact is also highly unpredictable.

Countries tend to first avoid or build resilience against those risks that are both high frequency and have high consequences. This is easier when there are resources, so as countries become wealthier, they have a smaller proportion of normal risks as they invest to avoid or increase their resilience to them. This leaves high-income countries with a greater proportion of HIRE risks and black swan events.

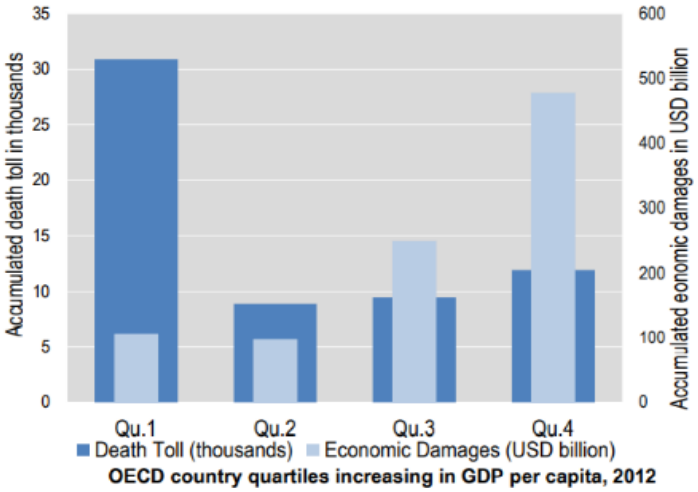
New Zealand has this standard high-income pattern, but we are also are exposed to both a larger number and greater frequency of catastrophic risks compared to most high-income countries, and this will mean that our approach to risk management will need to be different to other countries. This is discussed further when we consider the importance of building resilience.

The impact on people versus the impact on property

As countries increase their GDP per capita, the second big change in their risk profile is the relative balance between risks to people and risks to property. As societies increase in wealth, they focus more on addressing risks to people (life, health, safety), but at the same time, they have a higher value of assets at risk. This means there is a clear relationship where the level of economic damage to property increases but the risk to people, especially to life, decreases.

This pattern is most clearly seen in the outcome of natural disasters, many of which have a higher death rate but lower property damage in low-income countries, while high-income countries have lower death rates and a higher property loss. As Figure 15 shows, this relationship holds even within the high-income countries of the OECD.

Figure 15: The relationship between GDP, fatality rates and economic damage across OECD countries 1995-2010



Source: OECD, 2014, p. 32.

The outcome of both the Christchurch and Kaikōura earthquakes demonstrates that New Zealand conforms to the pattern of preferentially protecting life. The OECD found that, over the period 1980 to 2016, New Zealand had the highest economic loss (almost 0.90% of GDP compared to an 0.15% average) but our loss of life was at the OECD average (OECD, 2014).

The impact of the world risk environment

New Zealand's risk profile is influenced by the worldwide level of risk. The OECD recently released its review of the long-term trends on wellbeing and its distribution based on its Better Life Index. This showed that, in every part of the world, wellbeing has been rising significantly. At the same time, inequality has been falling, which suggests a larger proportion of society is benefiting from these trends. This is part of a much longer trend in reducing risks from the Middle Ages onwards.[11]

Worldwide risk has been declining for everyone, and New Zealand has benefited along with other countries. One example is how improved healthcare from discoveries overseas has improved life in New Zealand. In 1950, about 4.2% of children born in New Zealand died before they were 15, but now 0.5% die (https://ourworldindata.org/). As the world has become richer, societies have chosen to invest in areas that eliminate the high-frequency, high-impact risks such as reducing the burden of disease, and we have benefited from this investment.

As Figure 16 shows, in the higher-income countries, living standards improved because both average wellbeing increased and inequality reduced, decreasing the risks especially to those with lower wellbeing. New Zealand benefited from these trends. Just as one example, in 1871, despite having one of the highest standards of living in the world, only 60% of Pākehā New Zealand could read and write, and life expectancy was 52 years. (Māori were not included in these statistics at that time.) Now, literacy is almost universal and New Zealand's average life expectancy is over 82 years.

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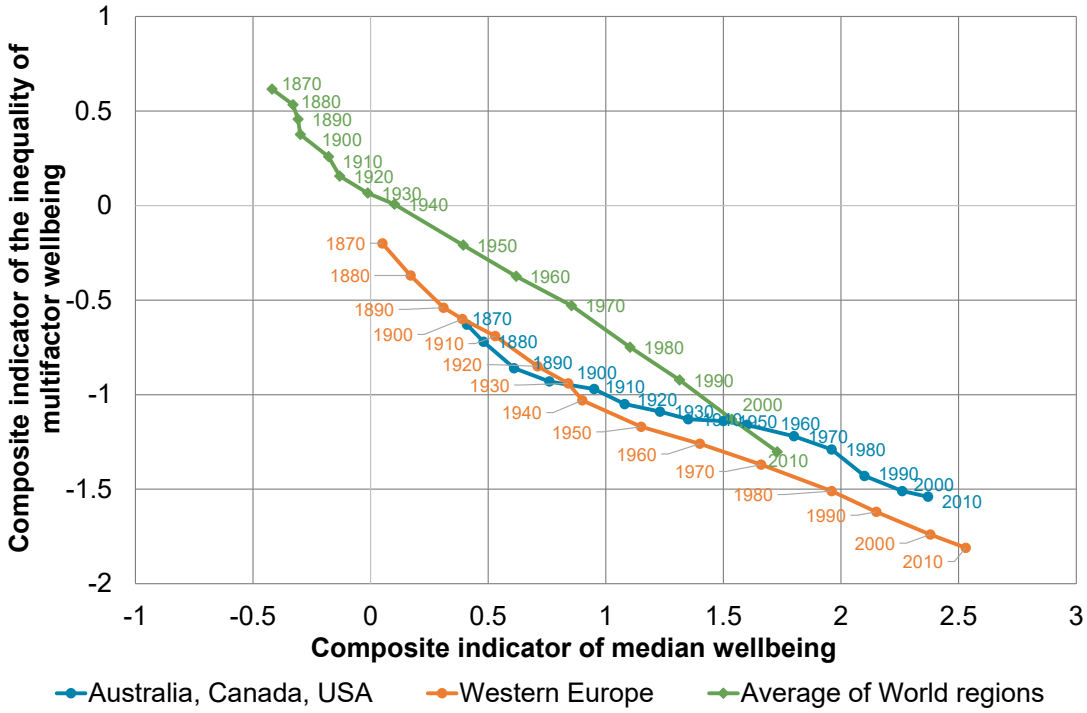
[11] There are many books on this topic such as Pinker (2011) and Rosling (2018). While the causes of this change are still contested, the trend is unquestioned.

Figure 16: Long-run wellbeing trends based on the OECD Better Life Index



Note: New Zealand was included but not separately identified in the study.
Source: OECD, 2021, pp. 255 and 257.

Assessing risks to our wealth and wellbeing

Figure 17 illustrates the broad range of risks that we face along with historical examples of the types of events tht have caused those risks. All of these risks could potentially have significant impacts on New Zealand's wellbeing. While most countries are faced with similar biological, technological, external and economic risks, only a few others face the same range of natural hazards.

To assess New Zealand's risk profile, we have focused on each of the four aspects of wealth individually, but we acknowledge that there are complex links between them. We also acknowledge that risks can compound particularly in a large event and that this compounding can mean that the negative outcome cascades for the individual and the community – for example, in an earthquake, those who are already socially isolated may find it more difficult to access the help they need. This characteristic often means that addressing risks requires a complex system of responses that adapts to the particular circumstances.

Figure 17: Some examples of the risks that New Zealand faces

NATURAL

Earthquakes
2011 Christchurch and 2016 Kaikoura

Tsunami
East Coast impact of 1960 Chile earthquake

Volcanic activity
2019 Whakaari/ White Island

Landslides
Cape Kidnappers coastal cliff collapse 2019

Coastal erosion
Hawke's Bay (Clifton to Tangoio) Coastal Hazards Strategy 2120

Severe weather events
Nelson/Marlborough Flood event, August 2022

BIOLOGICAL

Ecosystem disruption
Algal blooms from excess nutrients in lakes

Biodiversity loss
4,000 of our species are threatened or at risk of extinction

Pandemics
COVID-19

Communicable diseases
Measles and rheumatic fever

Plant and animal pests and diseases
- Kauri dieback
- M-Bovis

Food safety
Food-borne campylobacteriosis

TECHNOLOGICAL

Infrastructure failures
1998 Auckland power crisis

Major cyber attacks
Ransomware attack on Waikato hospital 2021

Industrial accidents
2010 Pike River

Innovations replacing our products
Synthetics carpets replacing wool

EXTERNAL

Armed conflict
The impacts of the Russian invasion of Ukraine on New Zealand

Territorial incursions
Potential for illegal fishing in New Zealand's waters

Transnational organised crime
Operation Freya drug smuggling and dealing investigation 2021

Espionage and foreign interference
In 2019/20 $70.5 million harm prevented to nationally significant organisations

Unauthorised migration & people smuggling

ECONOMIC

Financial Crisis
2008 Global Financial Crisis

Trade market shocks
1997/98 Asian crisis impact on exports

Supply chain constraints
Supply chain disruption due to COVID-19

Corruption

Risks to human capability

The last 100 years has seen a major lift in human capability

Human capability reflects attributes that are embedded in a person that are of value to that person as an individual and to society. The development of human capability is complex and subject to many different influences. We have simplified this section by only considering the two aspects that have the highest impact on human capability for wellbeing: health and educational attainment. Health is important because poor health reduces the ability of people to live the life they wish to have, and an untimely death takes away this opportunity completely. Educational attainment matters because it is the key driver for how well people will do in the labour market and because it is highly correlated with the other key wellbeing domains, including housing, health and social connections.

Over the last century, the capabilities embedded in people have become an increasingly important asset to wellbeing, both for individuals and the wealth of the nation. Rising human capability, particularly rising health and education levels, has been one of the major reasons why wellbeing improved and inequality in wellbeing (both within and between countries) declined as shown in Figure 16.

While measures of the value of human capability are not precise, they routinely show that, in a high-income country like New Zealand, the total value of the human capability embedded in the population is many times the value of the physical and financial capital of the country. In 2018, the embedded knowledge of people was at about 2.5 times the physical and financial capital stock in the New Zealand national accounts.

In He Ara Waiora, the concept of human capability is captured in Mana Āheinga, which speaks to mana in the individual's and community's capability to decide on aspirations and realise them in the context of their own unique circumstances. Health and educational attainment outcomes have seen increases for Māori in recent decades, although persistent gaps remain and are closing slowly. In addition, strengthening the Māori-Crown relationship based on te Tiriti o Waitangi and its principles is an integral part of building capability for Māori individuals, whānau and communities in future.

Health

There are two key major risks to our current health trajectory[12] – the increasing dominance of risk factors to health from lifestyle choices and losing the effectiveness of treatments either from new diseases or from the loss of efficacy of existing treatments.

Factors associated with lifestyle choices now dominate the risk of early death and disability, as measured by disability-adjusted life years (DALYs). The most significant of these in terms of impact are substance abuse (especially tobacco, which is the leading cause of health loss) and diet (Figure 18). Injury is also a significant contributor, with self-inflicted injuries and road accidents each contributing about a third of the DALYs lost to injury[13] (Ministry of Health, 2020; Tobias, 2013) Mental health is also a

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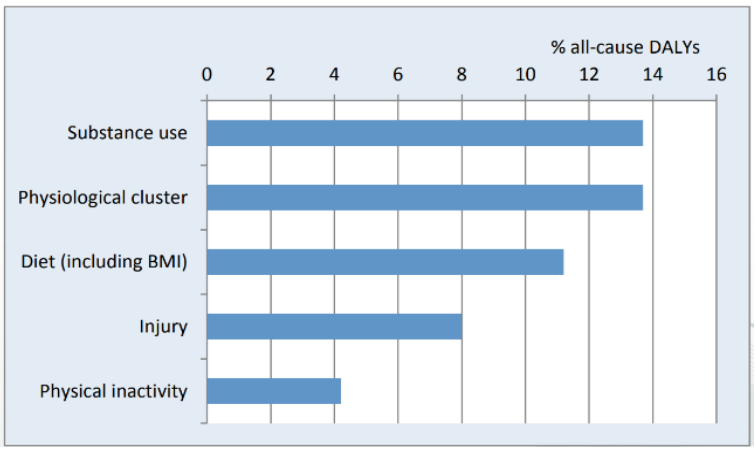
[12] Based on the United Nations 10 threats to global health. Ten threats to global health in 2019 (who.int). The other major risk to health and life expectancy is the collapse of government structures, which is more frequent in countries without a long history of stable government. We judge this risk to be very low in New Zealand.

[13] The other third is all other injuries from everything else.

significant contributor, and as the accompanying report on trends in wellbeing shows (The Treasury, 2022c), this is an area where New Zealand has not been performing well and the risks are increasing for young people.

Figure 18: Risks to health: risk factor clusters



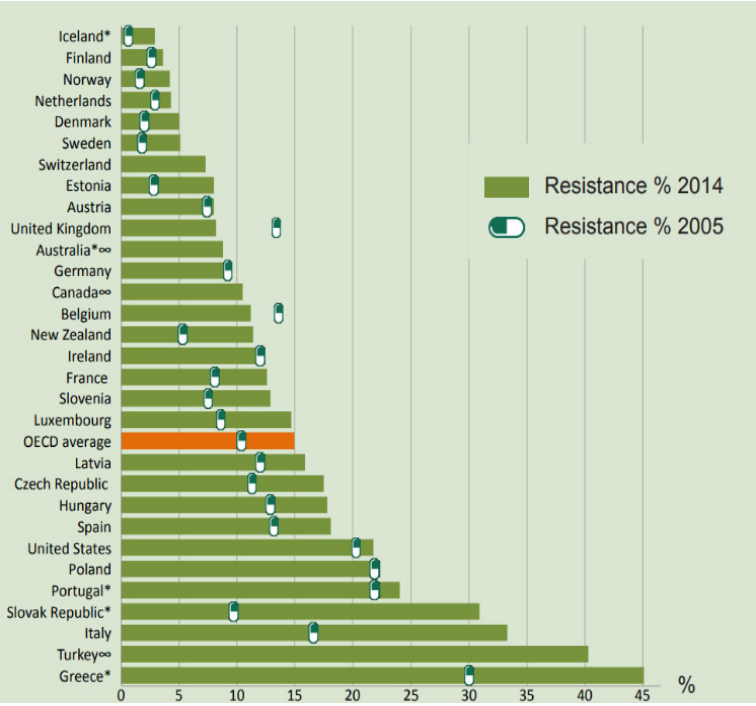
Source: Tobias, 2013, p. 20.

The second key risk is that the ability of the health sector to support high wellbeing will be undermined because of either new diseases or the fact that currently effective treatments are lost – the area of most concern is antibiotic resistance.

COVID-19 brought the first of these risks, and many countries in the OECD (though not New Zealand) saw a fall in life expectancy in 2020. COVID-19 has been a classic HIRE event where, while it was not unexpected, it was not expected to happen when and in the form it did. COVID-19 did demonstrate that, even in the face of a pandemic, New Zealand was able to mitigate the initial impact and that, globally, the scientific community was able, at least on this occasion, to find a vaccine quickly. However, this does not guarantee that the next pandemic will play out in the same way.

Antibiotic resistance is considered by the World Health Organization to be one of the biggest threats to global health (World Health Organization, 2020). Resistance is increasing internationally despite efforts to minimise the misuse of antibiotics in both humans and animals.Figure 19 shows that New Zealand's level of antibiotic resistance is below the OECD average, but it is not as low as in the best-performing nations, and the increase in our level of antibiotic resistance has been comparatively high since 2005. Addressing antibiotic resistance is an international issue, and the World Health Organization is coordinating various attempts to monitor the growth of resistance and to coordinate a policy response.

Figure 19: Antibiotic resistance rates, 2005 and 2014



Source: OECD, 2016, p. 2.

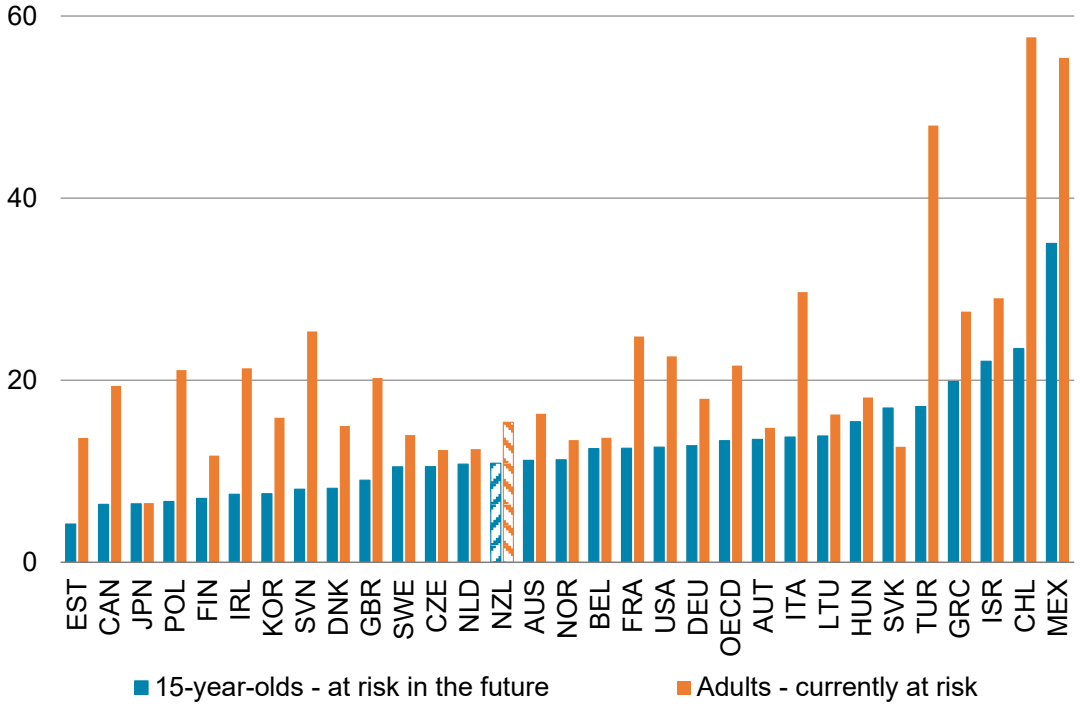
Skills levels and education

There is no consensus about how to measure the risk to individuals and society from inadequate human capability. For this report, we have used the metric of failing to achieve level 2 or above in any of the three core skills (literacy, numeracy and science) on the OECD's PISA 5-point scale study (which assesses skills at age 15) and level 1 in the PIAAC study (where we use the average proportion that fail to achieve in either literacy or numeracy). This approach reflects the fact that the average value of the PISA score and the educational attainment of the population are the two key metrics for the skills aspect of human capability in the Living Standards Framework Dashboard. The OECD believes that those who do not have this level of proficiency will struggle to achieve in a modern society (OECD, 2019a, p.4.). We have used a higher threshold for young people because there has been a long-term trend for higher skill requirements both globally and in New Zealand, so there is strong probability that skill requirements will continue to increase over the next 40 years (OECD, 2018b).

Recent research on New Zealand adults with low skills shows they have lower wellbeing on average. For instance, they have lower earnings (and reach their peak earnings earlier in life) and they have worse health, higher hospitalisation rates, an increased rate of substance abuse issues and a higher rate of criminal activity (Meehan, 2022).

Figure 20 shows that New Zealand has a slightly lower proportion of low-skilled 15-year-olds and significantly lower proportion of low-skilled adults than the OECD average. However, because this average includes some lower-income countries, it is more appropriate to consider the English-speaking and Scandinavian countries that we commonly compare ourselves with. While we compare well on this measure for adults, we are performing less well for 15-year-olds. Many other countries have lifted the performance of their young people and now have far fewer 15-year-olds with inadequate skills than New Zealand. (Australia has about the same level as New Zealand.)

Figure 20: Proportion of population at risk due to low skills – youth and adults

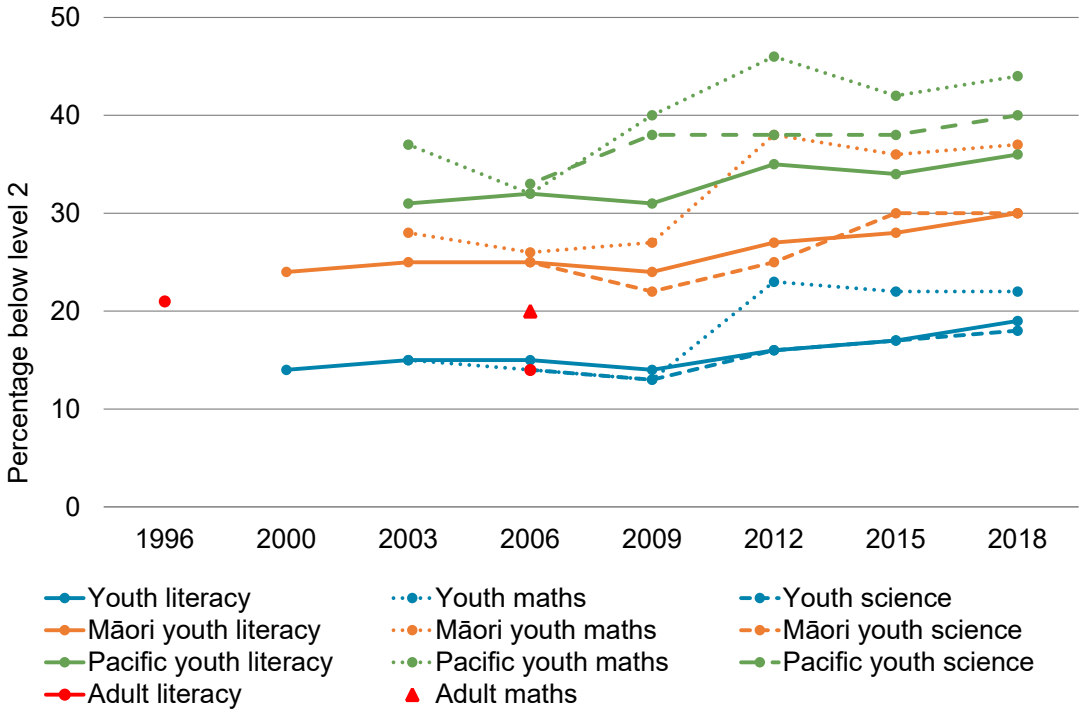


Note: Youth – PISA (level 2 and below); adults – PIAAC (level 1 and below).
Source: OECD, 2020, p. 121; OECD, 2019d, pp. 44 and 49.

New Zealand has participated in a number of OECD studies since 1996, and there has been a consistent trend for the proportion with low skills to rise over time (Figure 21). The proportion has also continued to be higher for and there is little sign of this disparity declining.[14] Our proportion of low skills is also higher for maths, which has been becoming a more important skill as the economy and society change. For instance, the OECD has found that numeracy skills had more impact than literacy on adult labour market outcomes such as employment and wage rates (OECD, 2013). This means that the overall skill level has declined further than a graph of the individual subjects indicates.

[14] The proportions in this graph are larger for youth than on the previous one because that looked at the number who had low skills in all three areas whereas this looks at each area individually.

Figure 21: Proportion with skills below level 2 on the OECD scale



Source: Ministry of Education, 2007, pp. 2-3; May et al., 2019, pp. 10, 15, 20, 38 and 39.

The trend towards lower skill levels is particularly concerning given that the growth in the aggregate value of human capital has been the most important component of New Zealand maintaining its level of weak sustainability, particularly in the World Bank measures. Without continued improvements in our skill levels, we may face the prospect of our wellbeing becoming unsustainable.

Further, low skill levels will impact people's employment prospects and lifetime income. These are the same skills that are needed to build an individual's resilience because those with higher skills find it easier to repurpose these skills as needed when forced to adapt to change in the face of unexpected events. This means lower skill levels could have implications for the adaptability and responsiveness of institutions and governance structures and therefore undermine the ability of the country to deal with risks and emergent sustainability issues.

The role of immigration

Until the COVID-19-related border closures, migration played an important role in providing the workforce with additional skills. In aggregate, migration has been adding more skills to the workforce than were lost from emigration (Figure 22). The closed border created risks that these missing skills could reduce production, but it was also an opportunity for changes in the skill mix or the level of capital investment.

However, sometimes migrants may not have the skills or attributes that employers value. In 2019, 28% of New Zealand migrants surveyed said their main job does not match their skills and qualifications, up from 23% in 2015. Of those 28%, almost half (43%) chose to pursue a different career, 35% reported not being able to get a job in their skill area, 28% said they were overqualified, 16% had qualifications not recognised in New Zealand and 12% said their previous work experience was not recognised. There are many reasons for this, but a key one is low English language proficiency (New Zealand Productivity Commission, 2021a, p. 16).

Figure 22: Net skill exchange from immigration and emigration, 2015-16

Table 1.3 Percentage of the population aged 15 and over, by education and immigration status, 2015-16

	Immigration	Emigration	Net migration
High education	39.6	20.8	18.8
Low-middle education	23.9	12.6	11.34
Total	**27.4**	**14.4**	**13.0**

Source: Carey (2019, p. 18).

Note:

1. 'Low education' refers to lower secondary education; 'middle' education corresponds to upper secondary education and post-secondary non-tertiary education; and 'high education' refers to tertiary education.

Source: New Zealand Productivity Commission, 2021b, p. 6.

The use of migrant labour to address skill shortages is not without risk. Many migrants add to the labour force by filling specialised roles, but the value of this depends on whether it is a substitute for training New Zealanders and the ability of the country to absorb the migrants (in terms of the impact on all the different aspects of wealth, for instance, housing, infrastructure and the impact on natural and social cohesion).

Risks to social cohesion

Social cohesion involves the benefits that arise when different groups of people, who may have different norms or values, still trust and cooperate with each other. The Living Standards Framework definition of social cohesion has two aspects: interpersonal links and the bridging social capital that links or coordinates between different groups (The Treasury, 2022b).

Using indicators of trust and civic norms in a sample of 29 countries, researchers found that trust and civic norms are stronger in countries with (i) higher income levels and less inequality of income (ii) institutions that restrain predatory actions and (iii) homogenous populations with high educational attainment … and economic growth. These findings are relationships… and causality should not be imputed to them. As our analysis says,

Because coordination and collaboration are important both for avoiding risks and dealing with them, improving social cohesion has the potential to both reduce risks and build resilience (Frieling, 2018). Various studies have also found that measures of social cohesion (such as trust and civic norms) have a positive relationship with economic growth and tend to be stronger in countries with higher incomes, lower inequality, lower levels of corruption, more homogeneous populations and higher education (Dasgupta, 2021).

The importance of social relationships for Māori society is reflected in different aspects of social cohesion appearing in two of the key elements in He Ara Waiora:

- **Mana Tuko Iho**, is the mana deriving from a strong sense of identity and belonging. Belonging and acceptance are among the most basic needs of humans as we are social animals. There are considerable risks to some of New Zealand's unique and indigenous taonga that speak to identity and belonging. It is well known that some key indicators of Māori culture such as te reo Māori have been in long-term decline over decades. Revitalisation efforts, which have been Māori-led and government-supported, have successfully prevented the extinction of te reo Māori and helped to build a new generation of highly proficient speakers. However, it would be premature to say that the language, which is a taonga unique to New Zealand, is fully future-proofed.

- **Mana Tauutuutu** is the mana found in participation in one's community. This is a notion that includes reciprocity – it means not only drawing on the support of others but meeting obligations to society and providing support to others where needed. Some basic indicators of this revolve around civic responsibility and community safety as well as wider social expectations such as paid and unpaid employment, which contribute to wider social wellbeing.

Norms and values

Norms and values are inseparable from culture. Different cultures will emphasise different norms and values among their members. "Culture embodies the conceptual and normative framework within which the members of a particular society, community, or other social grouping, are socialised, live, enter into relationships, think, communicate, and assign meaning to objects, events, and their very existence" (King & Waldegrave, 2003, p. 13).

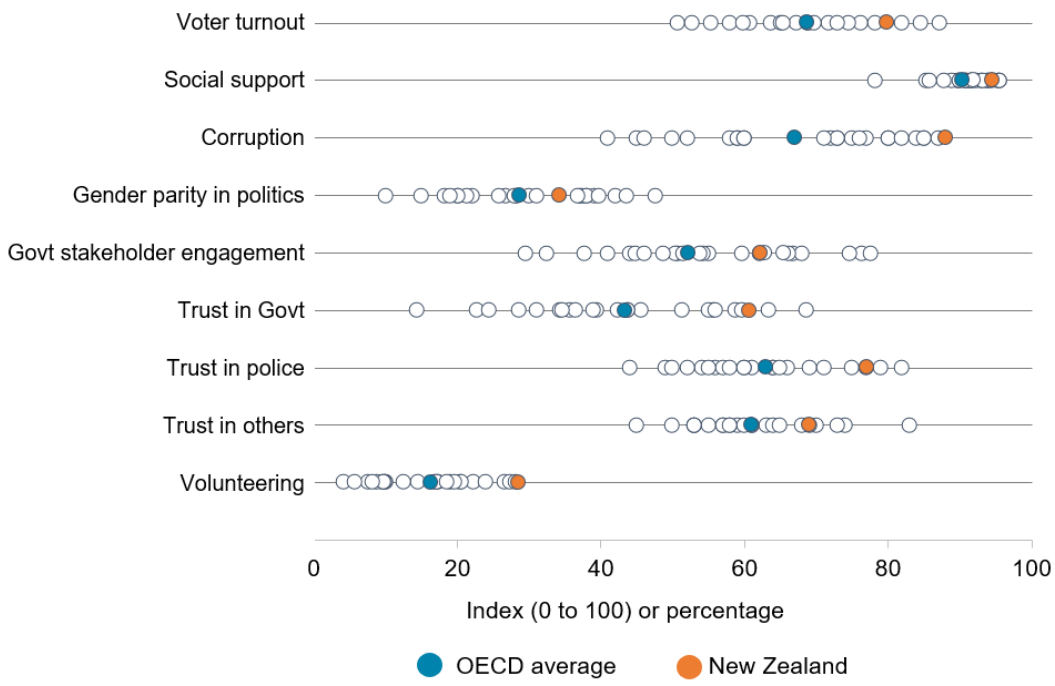
These norms and values influence our family structures, expectations about the social roles that we play, what we see as the role of government, the level of favours and support we can legitimately ask from our community and many other ways in which we interact. A disconnect between what people value and what they experience reduces their sense of wellbeing.

In 2018, the Treasury summarised the key risks to social cohesion found in overseas and New Zealand studies. One of most cited risks in the overseas literature is the ability of diverse communities to live in harmony with one another (Frieling, 2018). Population diversity has the potential to generate socioeconomic benefits such as productivity growth due to knowledge spillovers, trade facilitation through better cultural literacy, better-informed collective decision making and a greater variety of goods and services. Diversity can also challenge a society's overall sense of community, generalised trust and social connectedness. However, the empirical evidence for this is mixed. In the USA, communities with high levels of ethnic, cultural as well as political diversity tend to have lower levels of interpersonal trust and formal and informal networks, but the evidence from Europe and the UK is more mixed and points at income inequality and community deprivation as stronger determinants of social cohesion.

The three mitigating factors that build resilience in social cohesion are good governance, economic development and casual contact between people. Mixed neighbourhoods where people regularly interact tend to have higher social cohesion. People are also more likely to be trusting when they feel that they have previously been treated fairly by their fellow citizens (Roskruge et al., 2013). Challenges to cohesion may arise out of different life experiences or the level of opportunity provided to different parts of the community. These can be magnified by current events, social media trends and high levels of perceived discrimination, and they may become self-perpetuating if they discourage social connection. While the majority of New Zealanders report regular social contact, there is still a significant percentage who report limited attachment to their community (The Treasury, 2022b).

The OECD has a set of key metrics for social cohesion in their *How's Life?* report. By international standards, New Zealand has high performance on its metrics for social cohesion (Figure 23). However, the key metric for social cohesion is the level of trust (Dasgupta, 2021). On this key proxy for social cohesion, New Zealand is consistently high, whether it is measured as trust in government, in the police or in others.

Figure 23: New Zealand's position in *How's Life?* social cohesion metrics



Source: OECD, 2020, pp. 173, 186 and 235-243.

However, there is a downward trend in trust levels both in New Zealand and in many overseas countries, which may pose a risk in the future. This can be associated with a splintering of views or a lack of shared agreement, which can be magnified by social media and contribute to partisan politics, fractionalisation and the formation of stronger 'in groups' and 'out groups' with the consequential growth in distrust. Some ethnic groups in New Zealand have lower trust in government, and perceived levels of discrimination are materially higher for Māori and Pacific peoples (The Treasury, 2022b).

Risks to physical and financial capital

As a small trading nation, New Zealand is exposed to external economic shocks

Excluding natural disasters (covered further below), the main risks to New Zealand's physical and financial capital have come from its exposure to negative world economic events, which normally come through either declining terms of trade or through economic and financial crises such as the Global Financial Crisis. Externally driven shocks undermine the ability of the economy to generate income and to increase individual and national wealth holdings.

New Zealand is a small trading nation. This means it has been very exposed to international economic conditions. As Figure 24 shows, over much of its history, New Zealand has seen more volatility than most countries. Volatility matters because it increases the risks to households, firms and the nation from economic fluctuations. The uncertainty it creates also reduces the incentives for firms to invest, which reduces economic growth in the long run.[15] It also can lead to resources such as labour being unemployed during downturns.

A stable macroeconomic environment, though not enough on its own, improves certainty for households and businesses and supports them to make economic choices that will lift their wellbeing. Macroeconomic stability (where the Government has used its fiscal and monetary settings to minimise the country's vulnerability to shocks) can also improve socioeconomic outcomes as those at the lower end of the income and wealth distribution may be less able to smooth the impact of shocks (Resburg, 2022).

From 1870 to 2017, New Zealand had 33 sequences when its GDP per capita declined compared to an average of 22 for 15 other high-income countries.[16] Volatility was at its highest between 1951 and 1970, when New Zealand had the highest proportion of years of decline of this group of countries. However, since then, the level of volatility has reduced significantly, and from 1991 to 2017, New Zealand's volatility was close to these countries' average (Figure 24).

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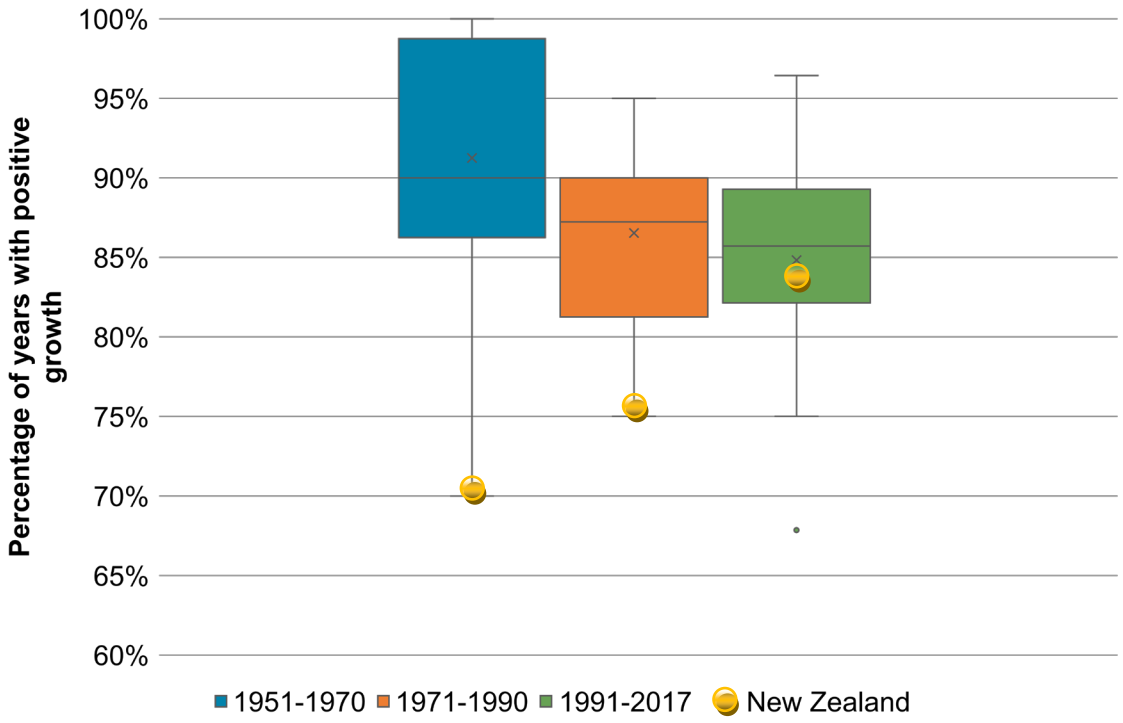
[15] This analysis is based on a paper by Broadberry and Wallis (2017), which showed the significance of shifts in volatility on long-run economic development.

[16] Australia, Austria, Belgium, Canada, Denmark, Finland, France. Germany, Italy, Netherlands, Norway, Sweden, Switzerland, UK and the USA.

Figure 24: The percentage of years with economic growth in New Zealand compared to other high-income countries



Source: Calculated from the Penn World Table (https://www.rug.nl/ggdc/productivity/pwt/?lang=en), GDP per capita.

New Zealand's lower volatility was part of an international trend towards a less-volatile international environment, often called the Great Moderation. The cause of the Great Moderation is the subject of lively debate among economists. Some attribute this trend to the changing structure of the economy, particularly the growth of the (much more stable) service sector and technological change. Others have stressed the importance of independent monetary policy, a floating exchange rate, more-stable fiscal policy through mechanisms like fiscal responsibility targets and financial innovations that increased access to credit. Still others look to innovations in firm behaviour such as better inventory management, which reduces the stop-start cycles in manufacturing (Everart & Iseringhausen, 2017).

Part of the difficulty in identifying the reasons behind this trend is that many countries changed the same key settings at the same time, particularly floating exchange rates (which mitigate the impact of terms of trade shocks through adjusting the New Zealand dollar price of exports and imports) and introducing fiscal responsibility approaches (which reduce the volatility of fiscal and monetary policy). New Zealand research found that most of the post-1960s volatility related to import prices as much as export prices (Grimes, 2006). It also found that the rapid growth of the service sector had been a key driver of lower volatility in the economy (Buckle et al., 2003) and that the lower concentration of New Zealand exports also helped reduce economic volatility (Borkin, 2006). There is also some evidence that the stability of monetary and fiscal policy also helped reduced volatility levels. While fiscal policy is believed to have been pro-cyclical during the economic boom in the early 2000s, since then, fiscal policy has become counter-cyclical, particularly during the early pandemic-induced downturn in 2020 (Resburg, 2022).

Geopolitical tension suggests higher risks

The period from the end of the Cold War until the middle of last decade was an era of increasing globalisation. The former Soviet states, Eastern Europe, parts of South-East Asia and China all entered the global system of trade and finance. New Zealand benefited from a period with a stable, rules-based, international system and freer trade. New Zealand exporters saw both greater demand in and access to offshore markets, and consumers were able to access a greater range of products and services at lower prices. These terms of trade effects meant that New Zealand's per capita income growth was significantly higher than it would have otherwise been (McLeish, 2022).

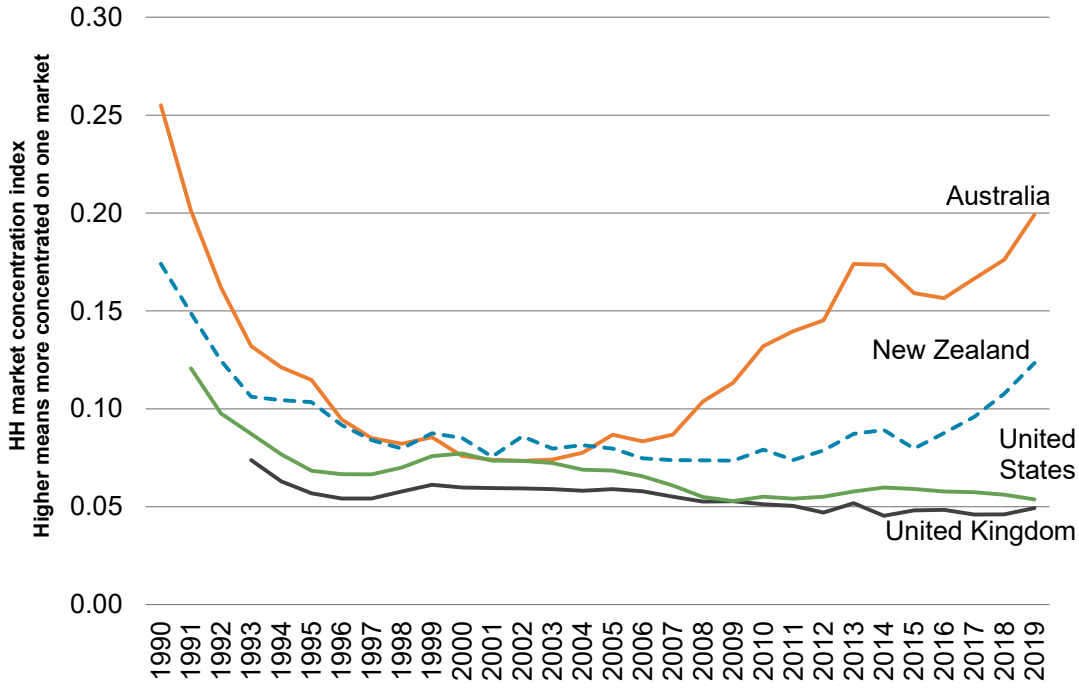
However, since the late 2000s, elements of globalisation such as goods trade and cross-border capital flows have been in retreat. More recently, great power competition between China and the USA is increasing. The global economy's historical reliance on efficient goods trade and capital flows between countries is under growing threat as governments increasingly view their foreign economic ties as levers to achieve other objectives, whether geopolitical (such as sanctions), political (such as protectionism) or development-oriented (such as China's boosting of domestic production). The institutions and rules that facilitate global trade such as the World Trade Organization are coming under increasing strain. Disruptions to supply chains caused by the pandemic and the war in Ukraine have only exacerbated these challenges (Blackmore et al., 2022).

In response, governments are becoming increasingly cognisant of the security of their supply chains, particularly for necessities (food, pharmaceuticals, energy) and critical inputs (such as rare earth minerals). Responses include increasing stockpiles (such as personal protective equipment), attempting reshoring of selected supply chains (for example, the USA and semiconductors) and seeking closer economic ties with "trusted partners" (usually their traditional diplomatic partners). Businesses are reassessing the just-in-time logistics model and considering the just-in-case model of keeping more inventory on hand.

These trends are a risk to New Zealand's economic capital in terms of our ability to both gain access to and benefit from growth in foreign markets. New Zealand's small size and geographic remoteness means that any transition away from our efficient global trading system risks inflating the price of our imported inputs and final products, adversely affecting New Zealand's levels of real consumption in the coming decades.

One source of risk is the concentration of what New Zealand exports (including services) and the level of concentration on a few markets or products. This can be due to the ease of doing business, which can be influenced by trade agreements and regulatory arrangements. New Zealand's trading patterns have diversified considerably since the 1970s when our key market was the UK and agriculture was the predominant export. However, over the last two decades, our trade with China has become increasingly concentrated, particularly for agricultural products, and this trend has intensified through the pandemic as many aspects of our services trade were halted. New Zealand is also heavily reliant on Australia as an export market and therefore exposed to domestic shocks there that would affect demand for our goods and services. The overall measure of market concentration, the HH index, is shown in Figure 25, and it shows the rapid rise in market concentration since 2010.

Figure 25: Index of the market concentration of all exports, 1990-2019



Source: https://wits.worldbank.org/

Risks from the natural environment

In the discussion around weak and strong sustainability, we considered the overall impact on the natural environment from stresses to it. There are very real risks, particularly in local areas and in agriculture, forests and the marine environment. These are covered in the companion report by NZIER (2022), and more detailed statistics are available in the Environment Aotearoa series.[17] This report will focus on the other major hazards from the natural environment. This discussion considers first the risk from climate change and then the other natural environment risks

Climate change

Climate change is one of the key risks of this time. It is included in this report because it is so significant, but we are only covering it very lightly because there are many other reports from international bodies such as the Intergovernmental Panel on Climate Change and local experts such as He Pou a Rangi Climate Change Commission (2021). These reports explore this complex and important risk thoroughly and in much more detail than can be included in this high-level overview.

Figure 26 summarises the key sources of risk from climate change. Climate risks include direct physical risks, including both slow-onset risks as the climate slowly changes and sudden risks through the increase in events like storms and heatwaves. There are also risks from the transition to a low-emissions economy, including the risks around whether the necessary technology will be developed, but as always, change brings opportunities as well.

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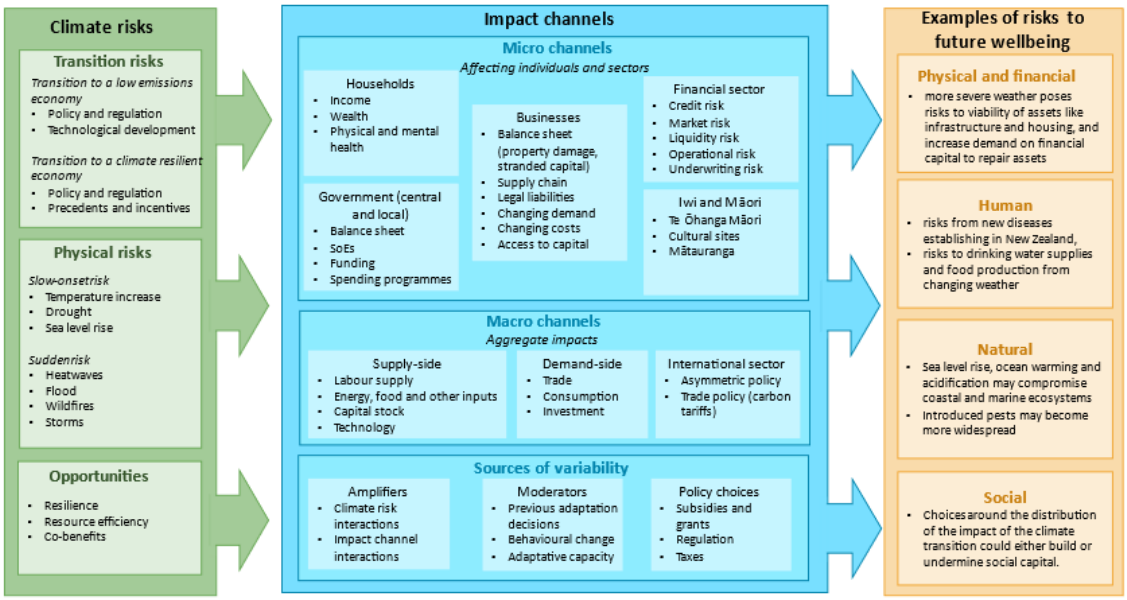
[17] https://environment.govt.nz/facts-and-science/environmental-reporting/

Figure 26: Risks, impact channels and wellbeing outcomes from climate change



Source: The Treasury.

It also shows that the impact will hit every part of society, including households, businesses, iwi and Māori, and government. There are many channels through which these risks will flow, including transition and physical risks, and many uncertainties because of the range of interactions that may amplify or moderate the impact. This includes policy choices that have their own trade-offs and impacts across our wealth. For example, a poorly managed transition to a low-carbon economy is likely to have negative consequences for social capital.

As a result, there is considerable uncertainty about the impact of climate change on the different capitals. The size, timing and distribution of the impacts depend on New Zealand's approach to adaptation (preparing for, managing or controlling the physical impacts of climate change) and mitigation (efforts to reduce emissions and so the magnitude of climate change). The one area where some assessment has been made is around the impact of using a carbon price to incentivise change on economic growth. He Pou a Rangi Climate Change Commission (2021) estimated these effects would reduce projected GDP by 1.2%, and NZIER's modelling (2018) suggested that GDP growth would range from 1.58% per annum to 2.03% per annum, depending on the scenario, compared to the status quo of 2.15% (The Treasury, 2021a). This impact may not be distributed evenly across the country or across the community, and it does not include any other costs that may be incurred in adapting to climate change.

From te ao Māori perspective, Te Taiao has been defined as the natural world, but this implies a degree of separation from human-made constructs such as societies, cities and industries. In fact, Te Taiao encompasses all the complex systems that make up the natural world, including humans, who form part of a web of relationships on which wellbeing depends.

Environmental degradation and global environmental threats impact the wellbeing of all New Zealanders but have particular significance for Māori communities and whenua in a number of interconnected ways. Māori communities are concerned about the severance of connections that people have with each other and with their ancestral land. These effects undermine the ability of Māori to fulfil their stewardship role for the environment and, over the longer term, limit the ability of their children to continue this practice in the future.

Of course, climate change is a global phenomenon. Without a significant global response, many of its negative impacts are expected to grow over time. This means that New Zealand's ability to mitigate this risk on its own is minimal. Building resilience to its effects by adapting to changes in our environment will therefore be especially important in moderating the overall impact on wellbeing.

Our other natural hazard risks are very high for a high-income country

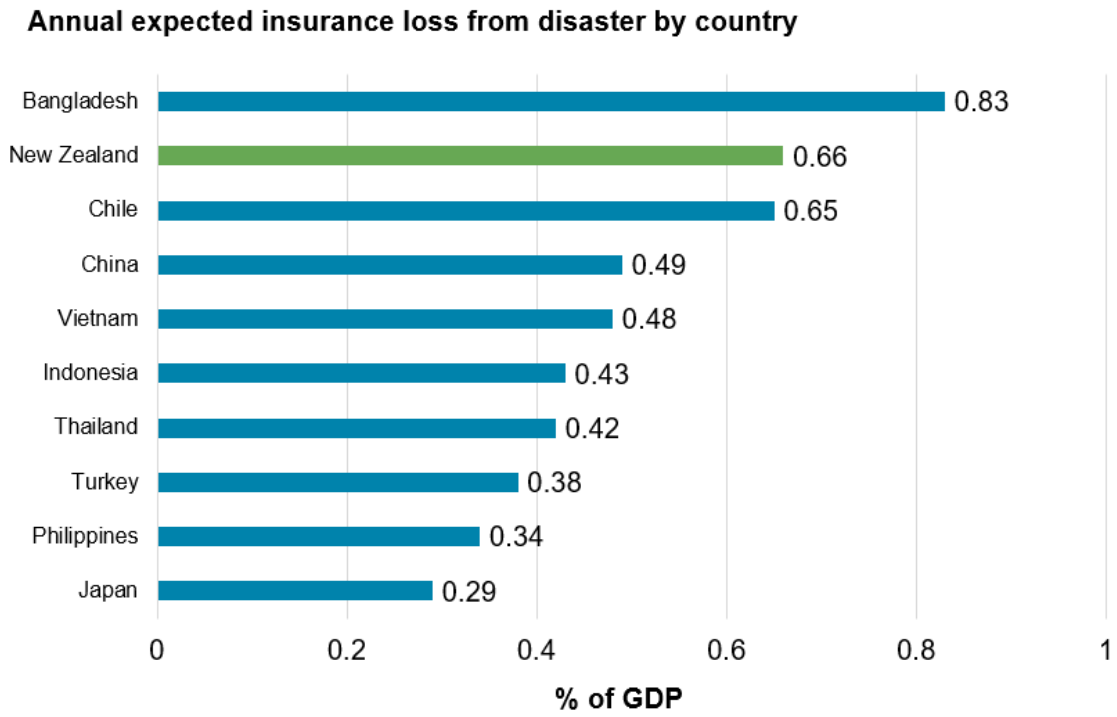
New Zealand's wellbeing faces significant risks from the natural environment. The biggest of the HIRE events that we face are from the earthquakes, tsunamis and volcanic events that result from our position on the Ring of Fire. Being a small country geographically further adds to this risk. What would be a minor event in a large country where the impact can be spread across many unaffected people and regions becomes a major event in a small country because the ability to spread the impact is lower. This means that options for spreading risks such as the reinsurance overseas of earthquake risk by Toka Tū Ake EQC are more important for New Zealand than they would be in a larger country.

International research shows that natural disasters are more frequent and devastating in low-income countries. High-income countries generally have more-robust institutions and organisational arrangements to build greater resilience. As a high-income country, New Zealand faces a significantly lower and more predictable level of risk because we have invested in more-resilient systems. These include preventive measures (like building codes for earthquake strengthening), transferring the risks (such as insurance by individuals and reinsurance by Toka Tū Ake EQC, which at least diversifies the financial impact) and systems for managing any events (such as food and water stores by individuals and civil defence plans).

Our unusual risk profile

On an international scale, New Zealand is exposed to a very high level of risk from its natural environment. This is particularly so compared to those countries that we normally compare ourselves with like Australia, Canada, the UK and the USA. Figure 27 shows the annual expected loss assessment by Lloyd's, the leading insurer. Lloyd's assesses New Zealand as having the second-highest risk of annual losses. Japan, another country on the Ring of Fire, is the only other high-income country in the top 10, and its risks are assessed as less than half of New Zealand's. This highlights not just the importance of the level of risk but also the importance of the size of the country in building resilience to the impact through having more people support those who are directly impacted by an event.

Figure 27: Aotearoa New Zealand's high exposure to natural hazards drives one of the highest rates of expected insurance losses in the world

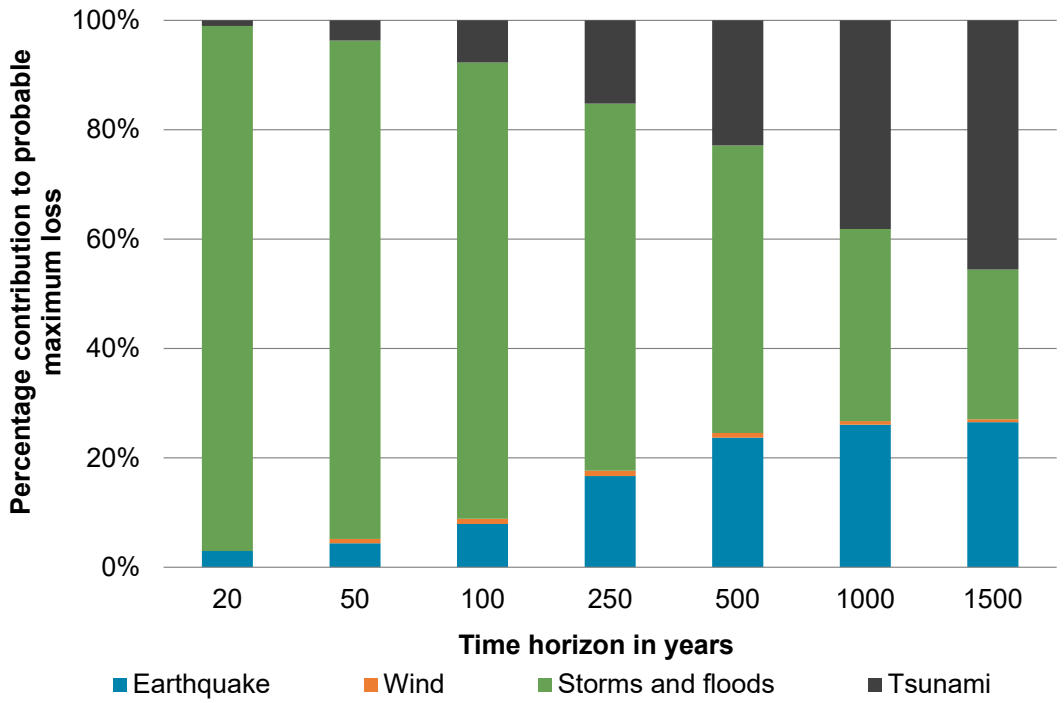


Source: Lloyd's, 2018, p. 14.

The United Nations Disaster Risk Reduction (UNDRR) database uses a consistent methodology to estimate the risk profile of each country, which captures both the probable loss and the frequency of both common and infrequent events.[18] Again, it reveals that New Zealand has a very unusual risk profile with a very marked difference between the mix of hazards in the short run and in the longer run. In almost all countries, the distribution of hazards over a 50-year period is very similar to the distribution over a 1,500-year horizon. This is not the case for New Zealand, where we face a different mix of hazards over a time horizon of 100, 500, 1,000 and 1,500 years. This change is shown in Figure 28.

[18] https://www.preventionweb.net/countries/nzl/data/ The description of their methodology is that it is based on "probabilistic risk assessment uses mathematical models to combine any possible future hazard scenarios, information about the exposed assets and the vulnerability, to provide results of an estimate of probable loss levels in a region of interest. Unlike historical estimates, probabilistic risk assessment takes into account all disasters that can occur in the future, including very intensive losses with long return periods, and does overcomes the limitations associated with estimated derived from historical disaster loss data".

Figure 28: Estimates of the hazard contribution of all risks over different time horizons for New Zealand



Source: GAR_Profile_NZL.pdf (preventionweb.net)

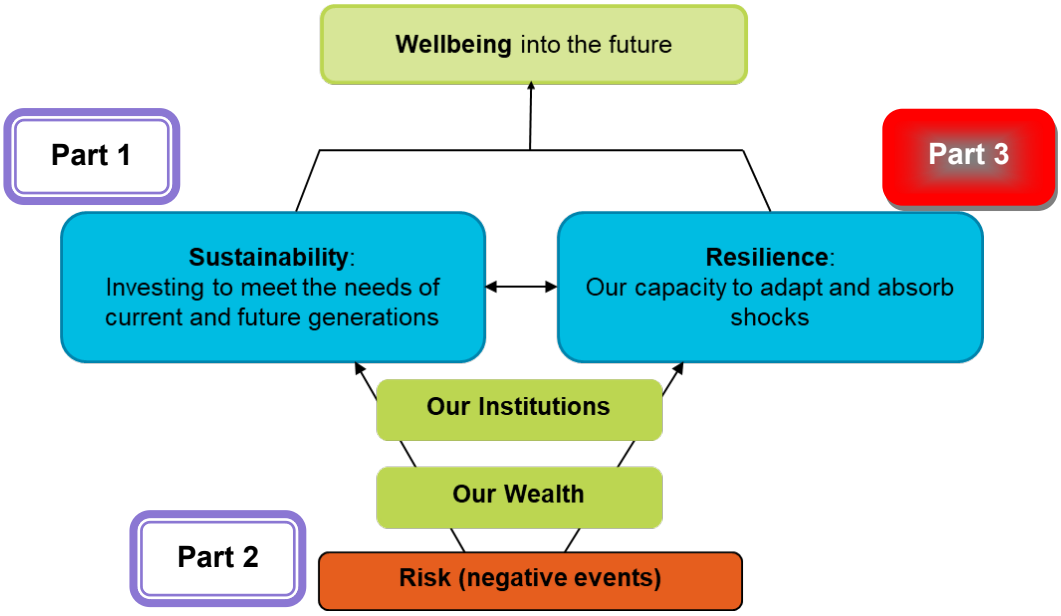
In the short run, our greatest exposure is to storm surges caused by adverse weather (because of the high proportion of the population close to sea level) and flood risks (because of their frequency). These are risks that are likely to be exacerbated with rising sea levels as a result of climate change. Despite recent experience, our exposure to earthquakes or tsunamis is assessed as modest by comparison. This analysis accords with New Zealand's non-earthquake insurance claims over the last two decades. The insurance claims also show how the mix of risks varies from year to year depending particularly on specific weather events (NZIER, 2020). This variability would be even more pronounced for regions of New Zealand.

> Given the incidence of frequent hazards and high exposure to hydro-meteorological and seismic events, New Zealand is ranked among the most vulnerably countries globally in terms of exposed GDP, and the average cost of hazards and disasters is estimated to reach 1 percent of the GDP annually. (UNDRR, 2020, p. 7)

In the longer run, our exposure to earthquakes and tsunamis dominates. This is because we have a higher exposure to hazards with low and comparatively unpredictable time-period events than most countries. In fact, the United Nations' assessment significantly understates our risk to infrequent events because the database does not include the impact of volcanic events. They did, however, note that 37% of New Zealand's population lives within 30 kilometres of a volcano compared to 7% in Japan, 10% in the USA and zero in Australia, Canada and the UK. The nearest comparable countries were Indonesia (28%) and Italy (14%).

While New Zealand is faced with a high exposure to natural hazards in total, this exposure has a highly unusual profile weighted towards infrequent but major events. This profile means New Zealand requires a unique mix of approaches to building resilience. This will be discussed in the following section.

Part 3: The role of resilience in future wellbeing



Key messages about New Zealand's resilience

There are no overall measures of the level of New Zealand's resilience to shocks. This reflects the fact that there is no agreed methodology for assessing resilience.

Resilience is built at individual, household, firm, iwi, community and national levels. It is the interweaving of the decisions across society that creates the overall level of resilience.

We have systems in place that enable us to prepare for and, where possible, prevent, our key risks. We also have spread the risks in some key areas such as earthquakes.

This prior preparation is important, but a key difference between New Zealand and most other countries is that our risk profile is highly skewed towards the less predictable and more catastrophic HIREs, which means our ability to react is at least as important as preparation. This requires strong institutions and governance.

The measures that are available suggest that we have relatively strong institutions and governance, which will help with ensuring that we have greater resilience. Our overall high social cohesion, with a very high level of trust in government and government agencies, is also one of the most critical resources for community resilience.

Why resilience is important to future wellbeing

Resilience is "the ability to anticipate and resist the effects of a disruptive event, minimise adverse impacts, respond effectively, maintain or recover functionality, and adapt in a way that allows for learning and thriving" (Ministry of Civil Defence & Emergency Management, 2019, p. 18).

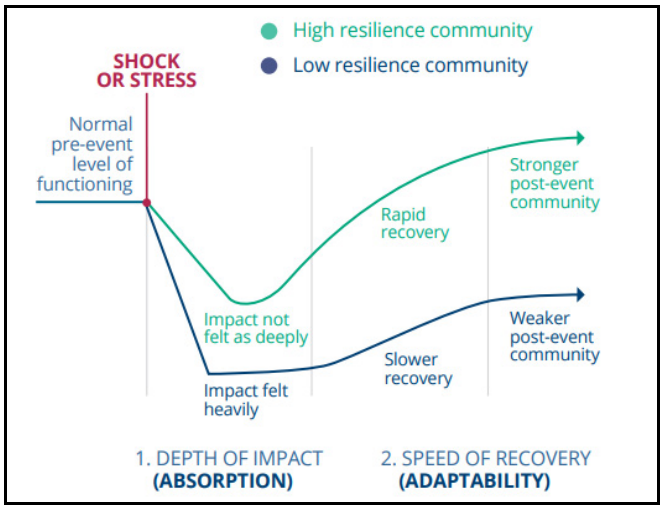
Resilience mitigates the impact of risk – whether it is a sudden risk or a slow-onset risk – on our wellbeing. It is also something that, at least in part, can reduce the impact of many risks that cannot be avoided. For this reason, building resilience is a key policy lever to reduce the impact of risk on the sustainability of wellbeing outcomes.

Resilience is built through having systems that can absorb the impact or have the flexibility to adapt to risk so that the exposure to and impact of risk is reduced. Resilience can be built through preparation to reduce the level of exposure to a particular risk and by an effective and appropriate response if the risk event happens.

The ability to adapt and transform is important. In some cases, the opposite of fragility is not durability but rather having a system that can react to the stress that eventuates. In his book on this concept, Nassim Taleb calls this "antifragility" (Taleb, 2012). Antifragility requires policy makers to search for solutions that benefit from uncertainty and volatility instead of being harmed by it. Complex systems, where the impact of the event on one part can be compensated for in another, are often more antifragile than simple systems, though they may look inefficient on the surface. Similarly, devolved decision making, where many people are seeking alternative paths to address problems rather than a central decision maker, may mean more-innovative solutions are created.

Resilience can be built through increasing the absorptive capacity of society or the environment, creating buffers that reduce the depth of the impact and/or the ability to adapt or transform the event to increase the speed of recovery (Figure 29). Resilience is important regardless of whether the risk is a sudden risk (like an earthquake) or a slow-onset risk (such as climate change) (Frieling & Warren, 2018.) As Figure 29 shows, if a shock can be absorbed, adapted or transformed, the negative impact on wellbeing will be reduced. The response to the shock may even provide an opportunity to increase sustainability through building back more resiliently.

Figure 29: How resilience builds sustainability after an event



Source: Ministry of Civil Defence & Emergency Management, 2019, p. 18.

Managing risks well

Resilience matters for all levels of society and cannot be built by government alone. The extent to which risks finally impact on the sustainability of wellbeing depends on the extent to which they are overcome by the resilience of our institutions (the individual, household, iwi, firm or country).

There is no single way to build resilience

Different types of risk require different approaches, but for all types of risk and regardless of whether it is being managed by the individual, household, firm or government, resilience is higher if:

- there are strong decision-making processes that enable those making the decisions to plan for risks and, equally importantly, adapt to unexpected outcomes
- there are flexible assets that decision makers can use to overcome unexpected obstacles – the ultimate flexible assets are people who are able to respond quickly, potentially into different roles and functions, and access to a pool of money (savings or access to borrowing).

The ability to manage any particular risk by building resilience depends on three key variables:

- **Information:** Who has the information to enable the risk to be managed well? Individuals, firms, iwi and local communities often have the best information about their own activities and how to balance the potential loss from a risk with the gains that may accrue from taking it. However, a key challenge to risk management is a tendency for people to underestimate the impact and likelihood of infrequent events. This means that the government may want to provide information or, in some cases, regulation to avoid under-preparation.

- **Agency:** Who can address this risk? While many risks can be managed by the individual, household, iwi, community or firm, this becomes more difficult as the impacts of a risk extend more widely – for example, natural hazards. These types of risks require a coordinated response from decision makers across a region, industry or group. Often, these decisions will require the participation of local and central government to overcome non-cooperative behaviour, free-rider problems and differential time horizons. For instance, redundancy in electricity generation to mitigate earthquake risks won't be effective unless it is mirrored by redundancy in electricity transmission and distributions systems. Wherever the agency lies, it requires strong relationships across the institutions, groups and individuals that are the key to delivering an effective response. Trust levels may determine the most-effective agent, and it can also be impacted by willingness to act, which may be compromised by political imperatives at local and national government level. (Gluckman and Bardsley (2021) provide some New Zealand examples.)

- **Incentives:** Who has the incentive to get the right balance between the potential gains of risk taking and the potential costs – for example, new development in coastal areas at risk of sea-level rise? When the consequences of taking a risk are not well aligned with the gains for success, there is the possibility of moral hazard outcomes (when those who benefit when the outcome is good push the costs onto others when the outcome is negative). On the other hand, risk-averse decision making could lead to lost opportunities that would have improved wellbeing. Individual and community value systems may also change the incentives to address risks. Principles such as manaakitanga, with its ethic of care and valuing of relationships, are indigenous expressions of these values in He Ara Waiora.

Building resilience through prior preparation

Normal risks that are frequent, idiosyncratic and relatively low in impact generally can be managed by individuals and firms as they are small enough for them to determine what to do (agency), they are largely the ones affected (incentives) and they have enough information to assess the probability of the risk happening (provided there are no significant cognitive biases).[19] Further, leaving the choice to manage these risks with those who have the potential to gain by taking them has the advantage of leaving the trade-off between the risk and return of the choices, so encouraging desirable risk taking.

The options for building resilience to reasonably predictable risks are described by the ACTA framework, with the choice of which option to take being driven by the costs and benefits for each risk:

- **Avoid** the event – by eliminating the cause or the exposure.
- **Control** the event – by taking action to reduce the probability or the impact such as building in redundancy so that, if one part fails, not all fails.
- **Transfer** the impact – most often through insurance, though this transfers the financial impact and not the human impact.
- **Accept** the event – but make contingency plans for managing it when it happens.

New Zealand has many ACTA systems in place that build resilience across a wide range of risks. Some government-focused examples are building regulations and Toka Tū Ake EQC insurance against earthquakes and other natural hazards, health and safety regulations and financial markets regulations. The government also spends on maintaining a civil defence infrastructure and other ways to respond when events happen (Figure 30). Because New Zealand is comparatively small, some of these systems also spread the risk beyond the country. While we cannot avoid the personal impact of events like earthquakes, the financial impact can be reduced if the risk is spread outside of New Zealand. This is the thinking behind the reinsurance undertaken by Toka Tū Ake EQC, and there may be other areas where it is also an appropriate response.

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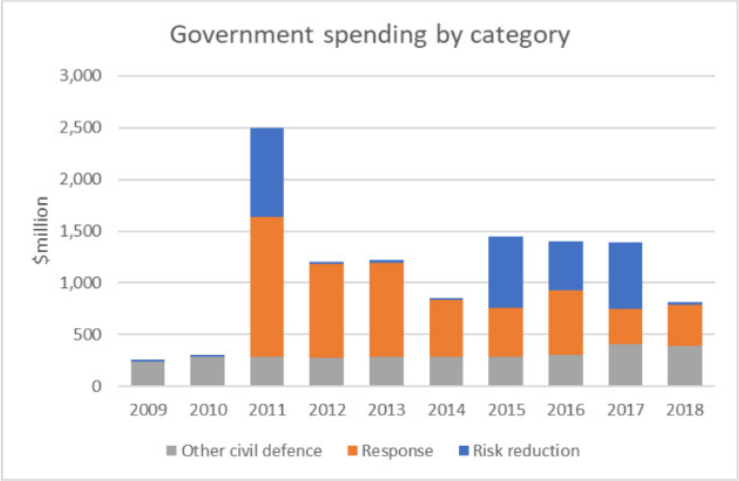
[19] The exception is international risks such as armed conflict or terrorism.

Figure 30: Government spending on disaster risk reduction, response and civil defence



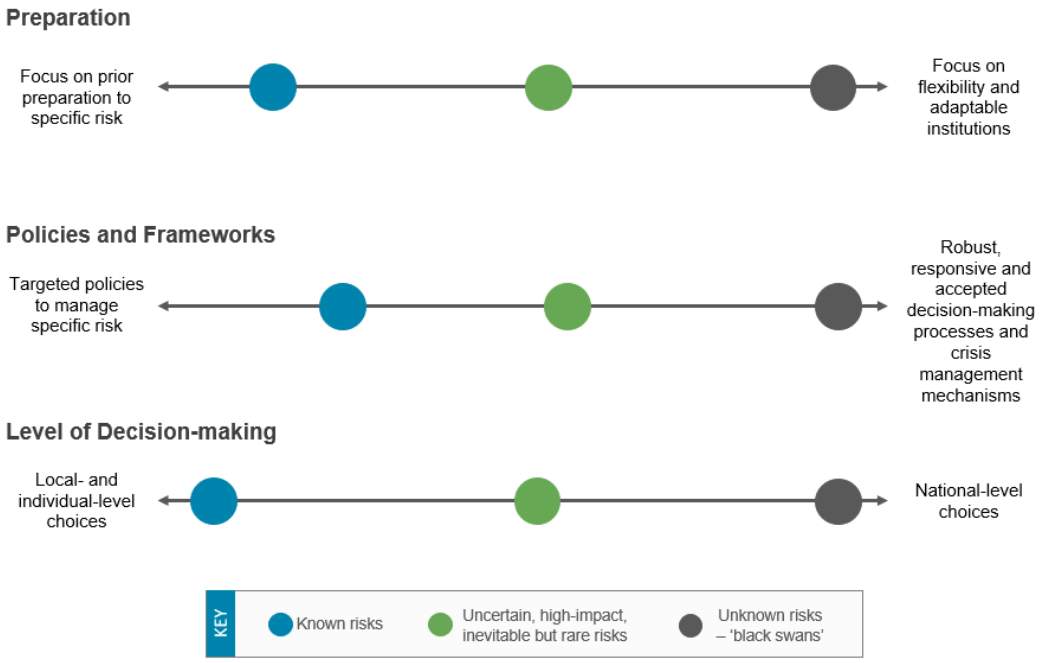
Source: NZIER, 2020, p. 15.

The limits to using prior preparation to build resilience

Managing HIRE risks, which are inherently less frequent and higher impact, almost always requires coordination beyond the individual and firm level. While ACTA is still a very useful framework for thinking through the options, its effectiveness becomes more limited as the level of uncertainty increases. For instance, as risks increase in uncertainty, it becomes more difficult to know whether preparation will be effective in avoiding or controlling the uncertain risk or its impact and whether too much or too little resource has been put into building resilience.

This means that, as certainty falls, the importance of generic rather than specific preparation increases (Figure 31). By the time the event is a black swan, the ACTA approach has little relevance as it is difficult to prepare for something that no-one expects to happen. This means that addressing unpredictable risks requires strong decision-making processes to react to unexpected events or impacts in an appropriate way. It also depends on access to flexible resources that can used to address what is needed when it is clear what is required. In New Zealand, we look to central government to perform this function.

Figure 31: Risk predictability and the balance between preparation and adaptation



Source: The Treasury.

Figure 31 shows graphically how, as uncertainty increases, resilience will increasingly require coordinated intervention, flexibility of the decision-making processes and the availability of generic capacity (both resources and systems) that can be repurposed to do what needs to be done.

The OECD identified the shift between preparation and pre-planning to adaptive, flexible response as one of the key lessons learned from the Christchurch earthquakes. To be effective in leading through such events requires a high level of trust in the centralised decision makers prior to the event so that they can command the cooperation of all the others involved.

> Following the Christchurch earthquakes in 2010-11 … a new risk and crisis management paradigm has emerged that distinguishes exceptional events from more routine crisis. A traditional approach for the latter is based on risk mitigation measures and standard rules in the response phase. However, the former requires a revised approach that accounts for more uncertainty and complexity.
>
> OECD, 2017, p. 112.

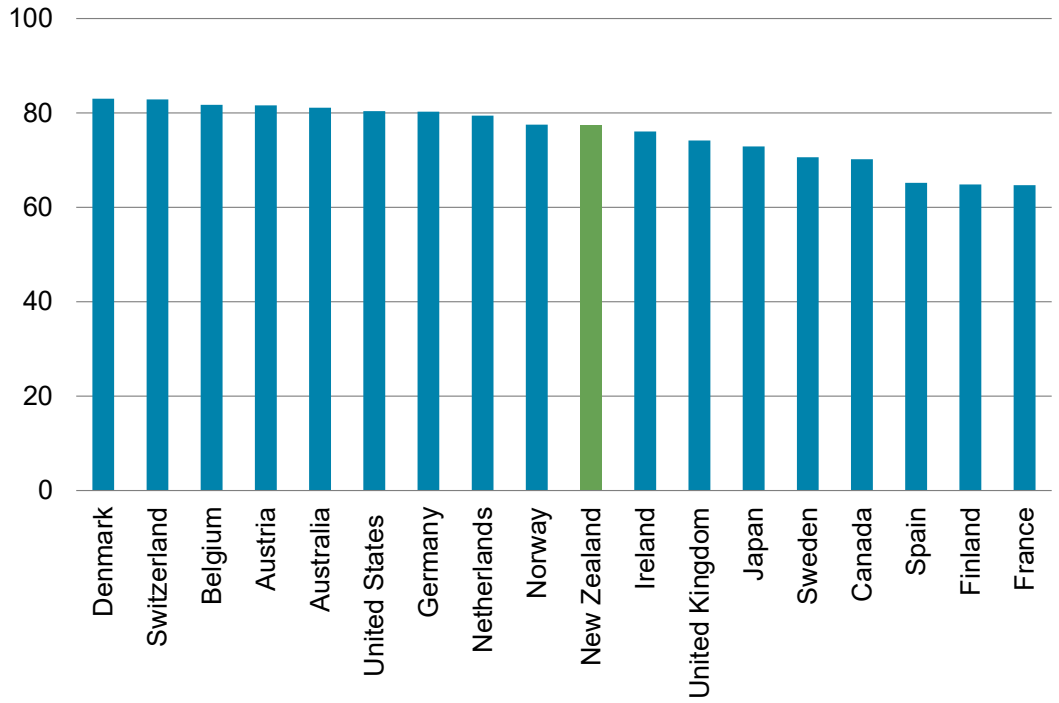
Evidence about New Zealand's resilience to shocks

There is no agreed methodology for measuring resilience prior to an adverse event. Most international attempts have focused on disasters in low-income countries or the after-the-fact experience of recovery in a high-income country rather than measuring resilience prior to a shock. For high-income countries, resilience measures have mainly been undertaken by cities – or, at most, regions – and each is based on ad hoc metrics rather than an agreed method. For instance, when the United States Federal Emergency Management Agency reviewed its community resilience indicators, it found there were 73 different methodologies with more than 100 indicators of which only 20 were commonly used (Edgemon et al., 2018). Few countries have a national resilience measure, and most, like the Australian Disaster Resilience Index, focus only on natural hazards.

Businesses, especially insurance companies, have an interest in knowing the resilience of countries, and there are two resilience indices that have been created for these purposes – the FM Global Resilience Index[20] (where New Zealand ranks 19th out of 130 countries) and the Swiss RE Resilience Index[21] (where New Zealand ranks 10th out of the 31 countries). Both indices cover a wide range of resilience markers as outlined in Appendix B. They use quite different approaches with the result that the correlation between the two is not high.

Figure 32 shows New Zealand's resilience ratings compared to the 18 high-income countries that are common to both indices. New Zealand's resilience is in 9th place, though this overstates the differences as the first 11 countries are all so similar that they effectively rate as equals. Both resilience indices are only available for a short period of time, with the longest, the Swiss RE index, only starting in 2007. However, this short period suggests that changes in resilience moves slowly, as New Zealand's place in both indices has moved little.

Figure 32: Total insurance companies' resilience scores



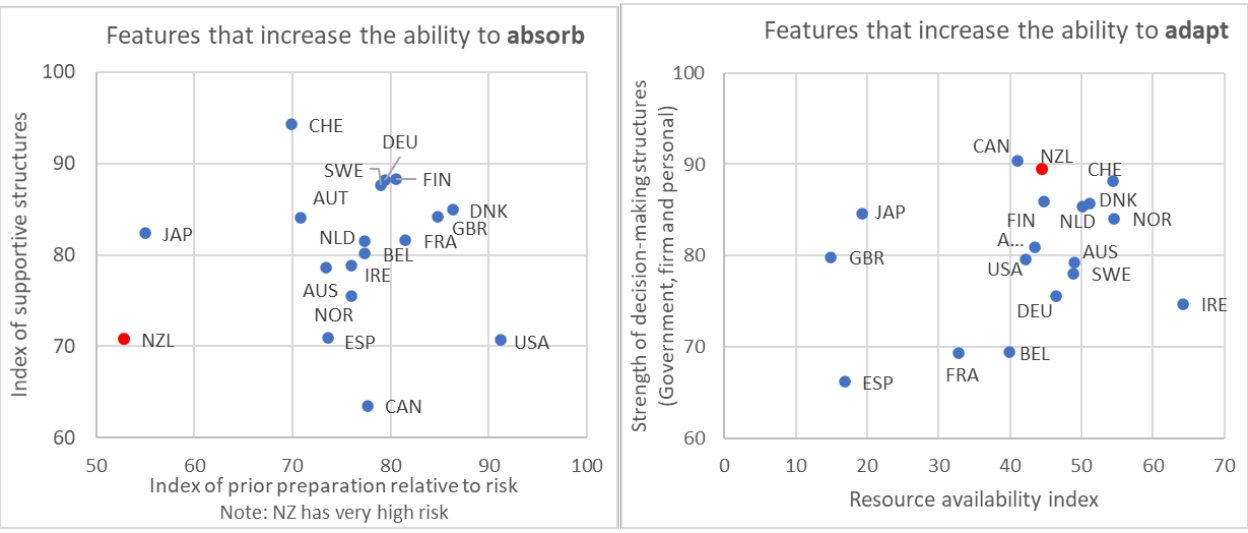
Source: Graphed data from FM Global and Swiss RE.

[20] https://www.fmglobal.com/research-and-resources/tools-and-resources/resilienceindex/explore-the-data/

[21] https://www.swissre.com/dam/jcr:3f36e9da-fe0f-401d-8648-9a12770ffc0f/2022-june-sigma-resilience-index-en.pdf

Disaggregating the metrics behind these two international resilience indices (Figure 33), it is possible to see where New Zealand sits in terms of its features that increase its ability to absorb the impact of an event (through prior planning or resilience-building general settings) and those that increase the ability to adapt after an event (through strong decision-making institutions and resource availability). New Zealand sits in the middle on most of these metrics (especially as the regulatory environment for buildings is adjusted for the level of risk in the country), but it is ranked especially highly for its decision-making institutions, which are assessed at a national, firm and individual level.[22]

Figure 33: New Zealand's assessed ability to absorb or adapt in a crisis event



Source: Treasury calculation using the FM Global and Swiss RE metrics. See Appendix B for the measures in each series.

Credit rating could also be seen as partially an indicator of resilience (especially to economic shocks), and New Zealand's high credit rating[23] suggests that the rating agencies considers the decision-making environment strong. New Zealand was one of only a few countries who had a ratings upgrade during the pandemic.

The importance of institutions and governance

New Zealand's natural hazard risks are unusually focused on long-cycle, uncertain, high-impact events. As shown in Figure 33, this means having relatively strong performance of decision-making structures is important for managing our risk profile.[24]

The Treasury has recently included a level called Our Institutions and Governance in the Living Standards Framework. This addition reflects the fact that institutional arrangements and effectiveness of governance mediate how our wealth is used to achieve outcomes in the wellbeing domains (Frances, 2004).

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22 The metrics and how they were attributed to each category are shown in Appendix B.

23 Currently Aaa (Moody's), AA+ (S&P) and AA (Fitch).

24 Raschky (2008) stresses the role of institutions, while Noy (2009) concludes higher literacy, better institutions, higher per capita income, openness to trade and government spending are all important.

Institutions are understood as bundles of rules, norms and roles that codify and reflect shared values. Institutions include both formal rules (such as laws and regulations) and informal conventions (such as customs and more). Because institutions govern decision-rights, they are important for determining how society makes decisions about preparing for risks and reacting in the event of a negative shock. They are also important in determining the ability of society to decide how to address issues around ensuring sustainability.

While values may vary across the community, the consensus determines the way in which a society chooses to make decisions and shape how people behave and what they expect from both themselves and others, including the government.

One of the key factors in the institutional environment is whether decision-rights are spread across society or whether they are concentrated in a small group. Concentrated decision-rights have been shown to undermine both stability and growth because decisions are focused on maintaining the power and wealth of this group (Raschky, 2008). They may also control the flow of information, which reduces the ability of others to make good decisions. For risk management, it is important to have an institutional structure that is focused on wellbeing across the community (rather than for an elite subgroup). A system that both respects and supports the decision-making rights of individuals, households, communities and firms is more likely to lead to good decision making by everyone involved in a crisis.

Institutions, prior preparation and the impact of COVID-19

In October 2019, the Global Health Security Index was released. It assessed the preparedness of each country in the face of biological threats – particularly from infectious diseases. It used metrics to assess six aspects of the preparedness of each country: prevention; detection and reporting; rapid response; health system strength; compliance with international norms; and risk environment. The USA ranked top, followed by the UK. New Zealand was 35th.

Less than six months later, COVID-19 tested this preparation. It was clear that there was no relationship between the measurement of preparedness and the actual health outcomes, even though the index considered the obvious preparedness measures – like the number of doctors, hospital beds and rapid response systems.

However, there was one subsection that did show a relationship: deaths were lower when the metric for the overall risk environment was higher. This measured both government effectiveness and the socioeconomic resilience of individuals. It was these generic systems settings that either helped or hindered the response to COVID-19 rather than the specific preparedness focused on the health system.

Based on Abbey et al., 2020.

Institutions also allow societies to provide additional support to those who need it. Many shocks do not affect the population uniformly, and institutions such as government play a big part in redistributing the impact, including, but not only, through the tax and welfare systems. For example, the government had arrangements that meant that the cost of the Christchurch earthquakes was not just borne in Christchurch but rather spread through the world (through Toka Tū Ake EQC and other insurance), across New Zealand (through taxpayer support) and across time (through using debt rather than current income).

Government resilience needs to be matched by resilience in other areas

While government resilience is important when major risks eventuate, it is also important that regional community groups, Māori and iwi, businesses, households or individuals have built resilience to absorb or adapt to negative events. This section summarises the available information for each of these levels.

Regional resilience

The New Zealand Resilient Organisations, as part of a MBIE's Science Challenges programme, constructed a prototype New Zealand Resilience Index (NZRI) with a heavy weighting towards natural disasters (Stevenson et al., 2019). The index is based on the resilience capitals, which cover different aspects of social, cultural, economic, built environment, natural environment and governance (see Appendix C for details). The NZRI has only been produced once, based on data from 2017/18, so it cannot give a sense of how resilience is changing over time, and as a uniquely New Zealand index, it does not allow international comparisons. The key metrics are shown in Figure 34 with a map of the regional distribution of resilience across the country. Overall, the message is that resilience is particularly high in the major city areas but lower in the more sparsely populated parts of the country.

Figure 34: The regional distribution of resilience across New Zealand 2017/18

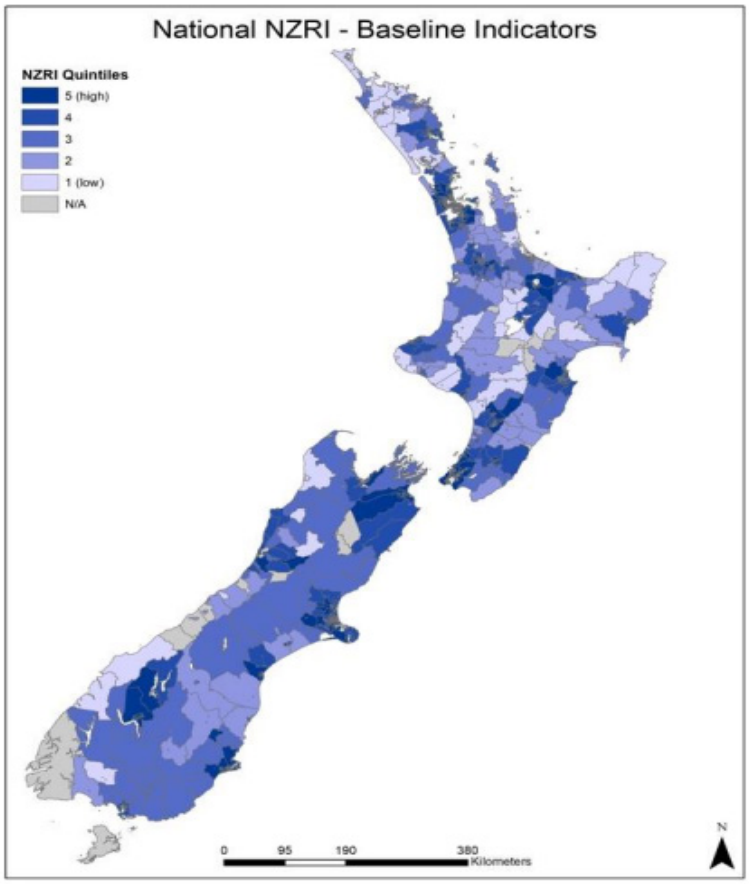

Figure 2. NZRI Scores shown by quintiles with 5 representing areas with the highest baseline scores and 1 with the lowest baseline scores. Note: CAUs vary in size based on population. More densely populated areas have smaller CAUs. As a result, it is not easy to the see variation within urban areas using a national map.

Source: Kay et al., 2019, pp. 6-7.

Māori resilience

In te ao Māori, there is a responsibility of caring for others and Te Taiao in response to a shock. Whanaungatanga creates a kinship-based form of capital that will be drawn on to aid whānau, hapū, and wider communities during times of adversity. Whānau, hapū and iwi respond quickly and collectively to provide support and address the immediate needs of their communities as well as to institute practices that will aid recovery and the development of disaster resilience in affected regions.

This process is considered whakaoranga – the rescue, recovery and restoration of sustainable wellbeing. The whakaoranga process is underpinned by tikanga, kotahitanga and the desire to ensure manaakitanga. These cultural attributes interact to co-create community and environmental resilience in the context of disasters.

The experience of the Christchurch earthquakes suggests that, in the face of an actual event, Māori values did provide significant resilience, but just as is found in the international literature, having ready access to resources is also important. In this case, there was strength of community-built resilience, but the economic vulnerability of the community also weakened its ability to respond.

Mana Āheinga is the capability of an individual, a whānau or a community to decide on their aspirations and realise them within the realistic context of their own circumstances. A strong sense of mana āheinga will likely also lead to a strong sense of resilience. People and groups who have more skills and capabilities to draw upon, alongside a stake in the future, are more likely to plan for risk. Obviously, this relies on a foundation of good health, knowledge and skills before broader aspirations of self-expression can be achieved. Building capabilities and turning them into action also requires hope and belief in the future. One very broad proxy indicator of this is life satisfaction – Aotearoa generally has strong levels of life satisfaction but they are persistently lower for Māori and Pacific peoples.

Māori resilience: the experience of the Christchurch earthquakes

The response and recovery of Māori to the massive dislocation of the earthquakes in Ōtautahi displays the strength and resilience of Māori cultural values and skills as well as the distressing effects of ongoing Māori economic vulnerability. The institutions of whānau, marae and iwi provided immediate and much needed help to more than just “their own”, and the values of whanaungatanga and manaakitanga were manifested in the actions of countless individuals and groups.

However, we make the comment that framing Māori resilience as somehow emanating from generations of poverty risks reifying the economic vulnerability of Māori and diluting attention from a key component of resilience to hazards and disasters, namely, asset wealth. (Lambert et al., 2012, p. 239)

Pacific peoples

Consistent with their values and beliefs, Pacific peoples perceive resilience as a community outcome (Chen et al., 2021). Community resilience in this context is the capability to anticipate risk, limit impact and bounce back rapidly through survival, adaptability, evolution and growth in the face of turbulent change Community resilience activities change their nature over time, from immediate post-disaster relief through to recovery phases and then longer-term community development work

The impact of the pandemic throughout the last three years has highlighted the strength and resilience of Pacific communities and families to respond to the pandemic and to begin the rebuilding needed to restore community and family stability and income impacted by the pandemic lockdowns and lengthy self-isolation requirements. Community resilience is not about (Pacific) communities enduring, tolerating and suffering through long-term, persistent disadvantage or structural inequalities. Rather, it is about coping and recovery, adaptation or more-transformative changes. Community resilience efforts should take existing structural inequities and the differing impacts of COVID-19 into account.

Discussions with Pacific leaders and the government officials involved in the response highlight resiliency as a key strength of Pacific communities and families.

Research into the impact of the COVID-19 lockdown on Pacific churches (Ministry of Pacific Peoples, 2021) and the churches' role in supporting Pacific communities found that churches and their leaders are key partners in community resilience and recovery, and a key mechanism for developing public policy and delivering services.

The ability of Pacific communities to consistently access and utilise local resources to respond to the threat posed by the pandemic to their communities and to the wider New Zealand public demonstrated a high degree of resiliency, innovation, and responsiveness across all communities at both regional and national levels. The strength of social cohesion within communities was clearly apparent throughout this pandemic. The focus of these capabilities has now been redeployed to assist the rebuilding and recovery as demonstrated in the increasing numbers of those in employment (Pacheco, 2022).

The rapid evidence review undertaken by the Ministry of Social Development (2021) post pandemic highlighted community resilience as a key factor in the ability of the Pacific community to withstand and mitigate the threats posed by the pandemic. The literature and research show that what counts for Pacific New Zealanders is the strength of social and cultural connections and the different ways connections and relationships are shaped and maintained (Ministry for Pacific Peoples, 2021). As with all communities, the research showed the importance of social connections, effective knowledge sharing and the level of trust in government and other key institutions. But to be effective, responses also need to be targeted to local needs, and this was most likely to be achieved when it was led by the community.

Resilience in the business sector

Business resilience is a key determinant of how well the economy weathers a risk as well as how well the community fares. Without business resilience, jobs are lost or incomes are impaired. New Zealand businesses have shown remarkable resilience to the COVID-19 shock, but they also showed significantly higher resilience to the impact of the Global Financial Crisis and even to the Christchurch earthquakes.

A pre-pandemic survey of firms about how they built their own resilience showed that, as in other areas, these focused on leadership and decision making, situational awareness (and understanding the key threats and opportunities) and innovation and creativity. Being able to harness the willingness of staff and those other businesses that are important to the firm to find solutions was also critical. The conclusion of the study was that business leaders felt that resilience was 50:50 – 50% preparation before the event and 50% adapting to the shock when it happened – and that either side of this was unable to cope without the other (Brown et al., 2015; Resilient New Zealand, n.d.).

In terms of managing risks before they occur, survey results found 26% of senior management thought risk management was mission critical to their businesses, and only 2% did not value it at all or were not sure. The majority (59%) also felt that investment in risk management was just right or more, with most of the remainder (34%) saying it was slightly too little. Figure 35 shows that, while there were a range of approaches to risk management, the most common was events analysis (Grant Thornton, 2016).

Figure 35: Proportion saying that they use this approach to risk management

	Public sector		Private sector		Not for Profit sector	
	2012	2015	2012	2015	2012	2015
Software	44%	53%	38%	68%	7%	43%
Key risk indicators	58%	55%	65%	73%	61%	71%
Quantitative analysis	27%	58%	37%	61%	14%	43%
Event analysis	84%	91%	87%	96%	79%	100%
External advisers	52%	72%	60%	66%	36%	86%
Organisational risk profile	84%	81%	71%	82%	57%	57%
Risk appetite statement	-	45%	-	57%	-	29%

Source: Grant Thornton, 2016, p. 12.

Resilience of households and individuals

For Te Tai Waiora Wellbeing Report, the Treasury has produced a report on the key factors that group the population into different segments based on their reported subjective wellbeing (Crichton & Nguyen, 2022). The differences between these groups can be seen as an indication of the key risk factors for lower wellbeing.

The factors that were most important for determining these segments were the person's mental health, perceived income adequacy, trust in in institutions and social connections. Using the preferred result for 2018, the difference in the average wellbeing scores for groups that share one or two of these characteristics but differ on another suggests that these are the key factors that act as both a risk and a source of resilience. The average subjective wellbeing score was 7.7 for the total population aged 15 or over. In addition:

- having an income that is perceived as adequate increases subjective wellbeing by 0.6-0.7 points (out of 10) regardless of whether the group involved are those with high, medium, or low mental health
- having good social connections (as characterised by either being partnered or reporting never being lonely) or having a high trust in institutions increases subjective wellbeing by 0.5-0.7 points.

Households and individuals have many ways in which to build resilience to shocks, but the most important are being able to spread the risk (either through access to a safety net or through insurance) and having savings (or being able to borrow) to cushion the impact of a negative shock.

There is evidence that people can tolerate a higher level of risk if there is support available if things go wrong, so countries with more-extensive welfare provision tend to also have people with a higher risk tolerance (Resburg, 2022; Bollard & Hunt, 2005). In essence, these safety nets spread the risk to individuals across a wider group.

The other way of spreading risk is through insurance. New Zealand households have a very high level of insurance, and this, according to Lloyd's assessment, materially reduced the impact of the Christchurch earthquakes on individuals and the country (Lloyd's, 2018). It is difficult to get cross-national comparisons, but in 2014, approximately 95% of New Zealand's privately held dwellings were insured against earthquake risk compared to 27% in Japan and 10% in California (both high earthquake areas). In the Treasury's view, it is very likely that the Toka Tū Ake EQC scheme contributes to New Zealand's high rates of residential catastrophe insurance (The Treasury, 2014, pp. 21-23).

Finally, having access to liquid financial wealth acts as a buffer. New Zealand research has focused on economic insecurity, which is defined as the risk that households will face a significant negative shock without having an adequate financial buffer.[25] The level of the shock was set as either losing 25% or more of their equivalised household disposable income or the equivalent impact through an unexpected increase in debt servicing, medical expenses or housing costs (Clyne, 2020; Clyne & Smith, 2022a, 2022b).

Economic insecurity affected approximately 11% of households over 2000 to 2021, which is lower than the approximate 18% in the USA between 2000 and 2012. Figure 36 shows that variations from year to year were closer to the unemployment trend (though tended to pre-date it when it was rising) rather than GDP growth. This suggests that economic cycles are important drivers of household economic insecurity.

Figure 36: The relationship of the Economic Security Index (ESI) to unemployment and GDP growth, 1999-2021

Source: ESI adapted from Clyne and Smith (2022b) updated by personal communication.

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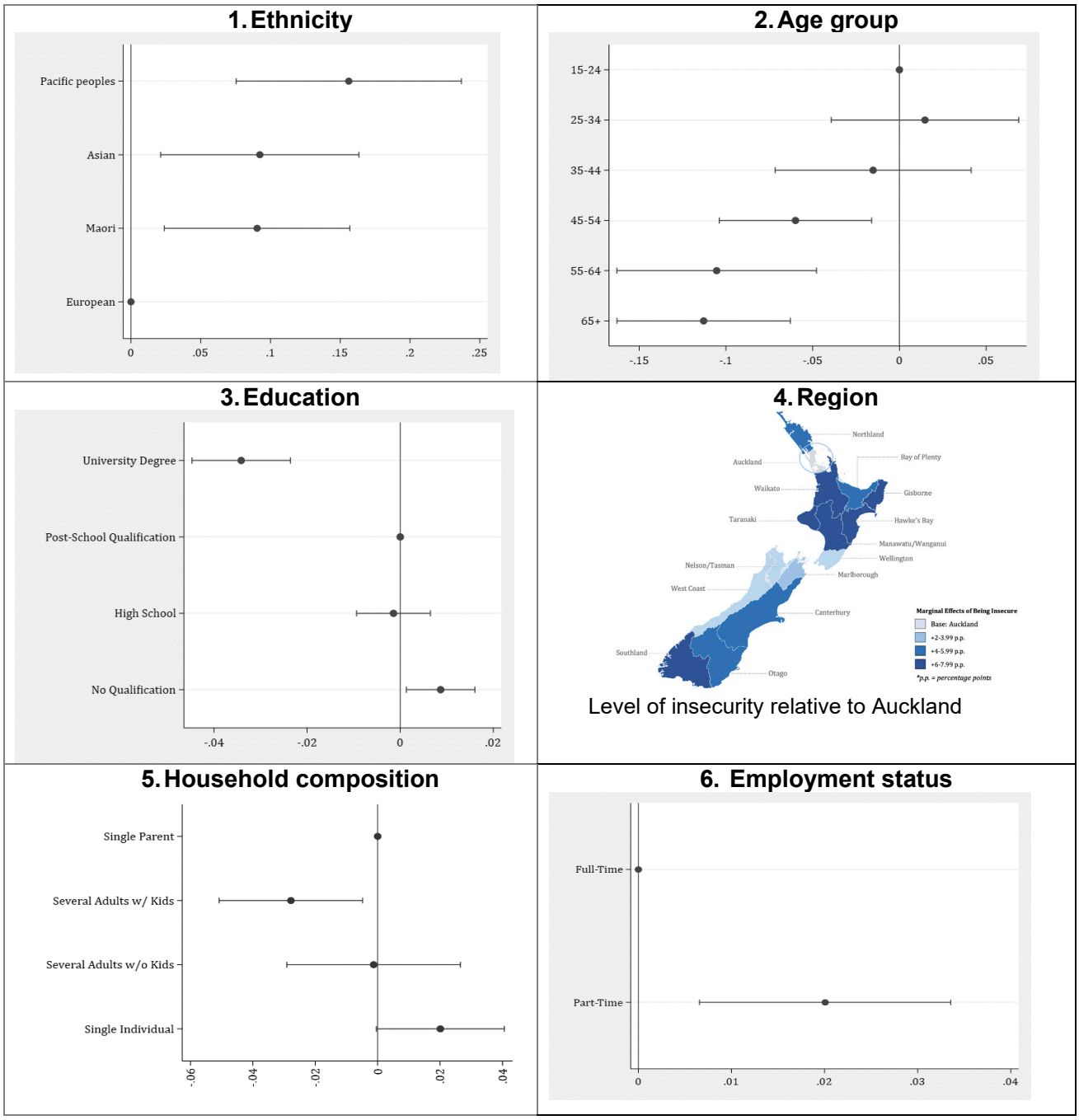
25 This research is based on methodology used in the USA. The ESI values used in this paper represent year fixed effects coefficients when household characteristics are regressed on income shock status. GDP and unemployment data are from Stats NZ (http://infoshare.stat.govt.nz/). The index did not consider income losses at retirement.

The distribution of insecurity across different household groups in New Zealand is shown in Figure 37. In both the USA and New Zealand, households are more economically secure if they have higher educational attainment, higher income and multiple adults in the household, and they are less secure if they are from an ethnic minority or are in a single-parent household. Another similarity is that business cycles are related to short-term fluctations in economic activity in both countries. However, in New Zealand, young people are more insecure than retirees, and while insecurity falls as incomes rise in the USA, in New Zealand, insecurity has an inverted U pattern, with both the lowest and highest incomes being more secure. This might reflect the greater effectiveness of welfare for those on the lowest incomes.

Figure 37: Distribution of economic insecurity across groups in New Zealand 1999-2021



Note: The further a group is to the right of the graph, the more insecure it is.
Source: Clyne & Smith (2022b), updated by Clyne (personal communication). Additional graphs are available on household income, relationship status and year.

Appendix A: Measuring comprehensive wealth

This appendix looks at the measurement of wealth for the purposes of assessing the sustainability of wellbeing. Measuring wealth involves two basic questions: (1) "what" should be included as wealth, and (2) if something is included, "how much" of it there is.

The "what" question is about the types of wealth and their components. The Living Standards Framework, in common with much of the literature, recognises four major types of wealth as relevant: physical and financial capital, human capability, the natural environment and social cohesion. "Asset", "capital" and "resources" appear in various places in the literature as alternative terms for wealth and its major types, but the concepts are essentially the same for the purposes of sustainability analysis. Within each type of wealth, sources differ, in some cases markedly, on which components to include on theoretical grounds. This makes a big difference to estimates of "how much" natural capital in particular there is in New Zealand.

A second analytically challenging aspect of "how much" is that wealth is necessarily a forward-looking concept. An attribute of any form of wealth is that it generates streams of earnings (in the form of wellbeing benefits) into the future. For forms of wealth frequently traded in markets, such as buildings, the value of future earnings is captured naturally ("capitalised") in the market price. For components of wealth that are not traded, measuring "how much" requires projecting the stream of benefits in the future and capturing them in the form of a "present value" of the stream. Since future benefits from any particular component of wealth depend on other components, this in turn requires a view about the future path of each type of wealth and how they work together (their "productivity" in terms of wellbeing).

Many of the potential choices in answering the "what" and "how much" questions required to measure the trajectory of overall wealth are subject to extensive debate in the literature. We illustrate this by considering the aggregates and each of the wealth types discussed in the main text.

The main text discusses two aggregate measures of Aotearoa New Zealand's wealth (called "capital" in both measures), one produced by the World Bank (with a measure of human capital for Aotearoa New Zealand provided by Le (2022)) and one by the UN Environment Programme. These provide time series measures of "how much" wealth there is, and hence can be used as indicators of whether or not wealth is increasing.

Both measures are aggregates of the present values of measured physical and financial capital, human capability and the natural environment, thus covering three of the four major types of wealth in the LSF. The chosen components are "monetised" – expressed in dollars as a common unit. The measurement approach can be summarised as:

- **Physical and financial capital**. This type of wealth includes human-made assets such as buildings and machinery, intellectual property and cultural artefacts, and financial net assets. It is straightforward to obtain quantities of many components of physical and financial capital, because they are bought and sold in markets in transactions measured in dollars.

In both the World Bank and UN Environment Programme measures, physical investment flows are cumulated to form the stock of physical capital, with assumed depreciation on the existing stock of physical capital netted off (the "perpetual inventory" approach). For financial capital, direct dollar measures of the stock are available from balance sheet accounts. Both organisations draw these statistics from the internationally standardised System of National Accounts (SNA) and Balance of Payments, facilitating international comparisons.

Notably, the SNA statistics do not cover all of the types of human-made assets listed above, and effective depreciation is not measured directly. This means the measures do not account for sudden large damage to the physical capital stock such as from natural disasters or other changes to the effective value of physical capital.

- **Human capability**. This includes knowledge and education, physical and mental health and cultural knowledge and capability. The concept of human capability and capital has been well-studied and a range of indicators in various units exist, such as test scores, qualifications, life expectancy and language ability. However, it is not straightforward to obtain monetised measures of human capability, because these things often do not have explicit prices or values attached.

  The technique used by both the World Bank and the UN Environment Programme, focuses on the future stream of labour market earnings due to human capability. The link between the two is now quite well characterised empirically, with the main predictors typically used being education, age (reflecting work experience and labour force participation) and gender (which empirically predicts labour force participation).

  Both organisations recognise the importance of health to human capability. However, because of measurement challenges, it is not included in human capability beyond its influence on labour market earnings through labour force participation. They also do not provide a monetisation of the cultural capability component of human capability. Finally, the approach based on the predicted future stream of labour market earnings does not count the other ways in which human capability enriches people's lives, such as the direct wellbeing benefits from education, good health and cultural richness.

- **Natural environment.** This includes all aspects of nature that support life and human activity directly or indirectly, for biological, cultural, spiritual or economic reasons. This necessarily expansive scope recognises the large variety of ways in which nature supports human wellbeing, many of which we are only beginning to understand. It also means that obtaining monetised quantities for all the relevant components of the natural environment is challenging. The most difficult challenges include converting the quantities in natural units (hectares of forest, hectolitres of water, number of species…) into dollar values, avoiding double counting, and projecting future wellbeing benefits in a way that takes account of how different components of the natural environment interact. Monetisation of the natural environment is heavily dependent on the assumptions used, many of which are less empirically well-characterised than for, say, human capability. This includes the underlying biophysical models needed to avoid double counting, for which the science is still very much developing.

Not surprisingly the measurement of monetised natural capital is where the two approaches differ most. The World Bank approach is based on concepts in the SNA, and for the natural environment, the System of Environmental-Economic Accounting (SEEA). Both the SNA and the SEEA monetise certain components of the natural environment based on the value that the asset would be exchanged for in cash, which in some cases can be derived from market prices (for example, for harvested timber or fish), and in others requires more complex thought experiments (for example, for the value of mangrove swamps in protecting coastal property from storm surges). The UN monetises components of the natural environment using a broader concept of the marginal contribution of the natural environment to total social value in terms of future wellbeing (the "shadow price"). The challenges of measuring this concept directly mean that it also has to use market prices as proxies for the shadow prices of many components (for example, cropland, agricultural land, production timber and fisheries). Both approaches require projecting the streams of benefits into the future.

A large part of the difference in monetised value of the natural environment between the two approaches appears to come from the contributions to wellbeing provided by forests beyond timber. Within this component, the World Bank includes only non-wood forest products, water services, and recreation services, which it values using market price proxies. The UN includes pollination, air quality and habitat for genetic diversity, to which it assigns high social values per hectare, and which the World Bank does not include.

- **Social cohesion**. This wealth consists of the willingness of diverse individuals and groups to trust and co-operate with each other in the interests of all, supported by shared intercultural norms and values. Although both organisations recognise the importance of social cohesion and broader types of social capital to wellbeing and supporting the performance of the other three capitals (the UN Environment Programme refers to social capital as an "enabling asset"), neither attempts to monetise it for inclusion in an aggregate with components of the other three types of wealth. Social cohesion is perhaps the type of wealth that is most difficult to monetise of all four and is not included in either measure.

For many significant components of wealth, both approaches project the stream of future benefits based on past observation. For example, the future income growth from human capability is projected based on past growth. This approach assumes that the components of wealth can continue to support wellbeing as they did in the past. It does not consider how depleted any of them might become over time, or what technological improvements might arise to allow new transformations of materials and knowledge and increase their effectiveness in supporting wellbeing. Both assumptions seem questionable in light of the evidence on environmental limits and the dynamic and innovative nature of economic activity.

There are many other differences between the two wealth measurement approaches in addition to those outlined above, and limitations to be aware of. Unlike the commonly-used SNA-based approach to physical and financial capital, measuring the other types of wealth and aggregating them to form a measure of overall wealth is still in its infancy. As discussed in the main text, the two aggregate measures outlined here suggest rather different pictures of the trajectory and composition of wealth in New Zealand, with opposite implications for the sustainability of wellbeing. These differences, and an understanding of how they arise from the different methodological choices involved, help shine a light on the complexities involved in wellbeing sustainability assessment and on the benefits of alternative approaches

Appendix B: Measures of resilience

The FM Global Resilience Index (where New Zealand ranks 19th out of 130 countries) and the Swiss RE Resilience Index (where New Zealand ranks 10th out of the 31 countries) cover a wide range of resilience markers. In each case, the index was the unweighted average of these subgroups of the index, with both indices scaled from 0 to 100.

	FM Global	Swiss RE
Regulatory environment	• Natural hazards – building code quality and enforcement (80%) and risk improvement (20%) • Fire hazard – building code quality and enforcement (80%) and risk improvement (20%) • Climate risk quality – building code with respect to wind-resistant design (80%) and level of wind and flood improvements given the risks (20%) • Cyber risk – internet penetration and civil liberties • Quality of infrastructure – transport (all modes) and utility infrastructure	• Insurance penetration – premiums to GDP
Supportive structures	• Supply chain visibility – ability to track and trace across supply chain • Energy intensity – total energy consumption divided by GDP • Urbanisation rate • Healthcare expenditure – expenditure per person	• Economic complexity for goods only • Banking industry backdrop • Banking industry backdrop – survey of the robustness of the system • Low-carbon economy • Income inequality
Decision making	• Risk of insurrection • Control of corruption • Corporate governance – strength of audit, conflict of interest, shareholder governance	• Human capability – health and education • Labour market efficiency
Resources	• Productivity – GDP per capita	• Monetary policy space • Fiscal space (government debt and net external debt to GDP)

Appendix C: New Zealand Resilience Index indicators

New Zealand Resilience Index is based on the resilience capitals, which cover different aspects of social, cultural, economic, built environment, natural environment and governance.

Resilience concept	Resilience capital	Weight
Buildings safety and functionality following a disruption	Resilience of the Built Environment	11.7%
Network infrastructure resilience (roads, electricity, water and wastewater)	Resilience of the Built Environment	11.5%
Levels of community networks and sense of belonging	Social Resilience	11.3%
Personal resilience capacities of individuals (e.g. education, physical and mental wellbeing)	Social Resilience	10.5%
Health system response capacity	Governance of Risk and Resilience	8.9%
Household capacity to cope with economic disruption	Economic Resilience	8.9%
Quality of legislation and plans addressing hazards	Governance of Risk and Resilience	8.0%
Household emergency preparedness	Social Resilience	6.7%
Economic diversity (businesses from several different sectors)	Economic Resilience	6.4%
Availability of natural buffers (e.g., green space, undeveloped flood plains)	Resilience of the Natural Environment	6.2%
Community access to shelters and welfare centres	Governance of Risk and Resilience	5.3%
Heritage and culture are valued and preserved	Cultural Resilience	4.7%

Source: Kay et al., 2019, p. 6.

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